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*RELATIONS OF THE NATIONAL GOVERNMENT TO HIGHER EDUCATION AND RESEARCH.**

WHEN one considers the relations of the General Government to higher education and research, probably the first question to arise is, What, within the limitations imposed by the Constitution, can the Government do? Other pertinent inquiries are: What has been done? What is the present policy of the Government? How are its educational resources being utilized? What can be done that is not already being well done by our universities, colleges and technical institutions?

Many of our wisest and best statesmen and jurists believe that the General Government has no power, under the Constitution, to appropriate money for educational purposes, that important function having been left to the States. A glance backward over the history of colonial and national discussion and legislation is interesting and instructive.

HISTORY OF COLONIAL AND NATIONAL DISCUSSION.

In colonial times Oxford, Cambridge and Edinburgh were to American youth the centers of learning and higher education. These famous universities furnished all that

*Substance of address before the University of Chicago, delivered June 17, 1901.

was needed by the well-to-do student, and local colleges were given little attention and scant support. The founders of our college system were obliged to meet adverse conditions which developed the same qualities that led their compatriots to the conquest of the continent.

Early in the seventeenth century (1619) the Virginia Company granted ten thousand acres of land 'for the foundation of a seminary of learning for the English in Virginia.' At the suggestion of the King, the bishops of England, in the same year, raised fifteen hundred pounds to aid in the education of the Indians in connection with the proposed grant of land for the seminary. A portion of the land was occupied and the seminary was started under the direction of George Thorpe, a man of high standing in England. But the institution was short-lived. It, with its inmates and founder, perished in the Indian massacre of 1622.

In 1624 an island in the Susquehanna river was granted for the founding and maintenance of a university, but the undertaking lapsed with the death of its projector and of James I. and the fall of the Virginia Company.

For a time the movement for higher education was delayed, but in 1636 Harvard was founded; then William and Mary, in 1660; Yale, in 1701; the College of New Jersey, in 1746; the University of Pennsylvania, in 1751; Columbia, in 1754; Brown, in 1764; Dartmouth, in 1769; the University of Maryland, in 1784; the University of North Carolina, in 1789–'95; the University of Vermont, in 1791, and Bowdoin, in 1794.

The university spirit was well developed when the Constitutional Convention met in 1787. Madison, who was a member of the convention, acting in harmony with the known wishes of Washington, proposed to give the National Legislature power—

> To establish a university.
>
> To encourage, by premiums and provisions, the advancement of useful knowledge and the discussion of science.

Charles Pinckney also earnestly advocated a plan for the establishment of a national university, and Mr. Wilson supported the motion; but the matter was dropped, on the ground that Congress already had sufficient power to enact laws for the support of national education.

John Adams, who agreed with Washington in believing that 'scientific institutions are the best lasting protection of a popular government,' was always a strong advocate of the promotion of intelligence among the people. He secured the insertion in the constitution of Massachusetts of a provision recognizing the obligation of a State to pursue a higher and broader policy than the mere protection of the temporal interests and political rights of the individual. This provision read as follows:

> It shall be the duty of legislatures and magistrates in all future periods of this Commonwealth, to cherish the interests of literature and the sciences * * * to encourage private societies, and public institutions, rewards and immunities for the promotion of agriculture, arts, sciences, commerce, trades, manufactures, and a natural history of the country.*

Washington sought to impress on Congress and the people his earnest conviction that the Government should establish and support a great national university. To this end he made a bequest in his will, and if Congress had treated it as the Legislature of Virginia treated his bequest for the endowment of Washington College, there would be to-day a fund sufficient to give adequate support to a great institution for investigation and original research in the capital city. In his will Washington expressed the fears he entertained as to the effect of foreign education on the youth of America, and the desirability of having an American university. His language was as follows:

* Massachusetts Public Statutes, 1882, p. 34.

That as it has always been a source of serious regret with me to see the youth of these United States sent to foreign countries for the purpose of education, often before their minds are formed, or they have imbibed any adequate ideas of the happiness of their own, contracting too frequently not only habits of dissipation and extravagance, but principles unfriendly to republican government, and to the true and genuine liberties of mankind, which thereafter are rarely overcome. For these reasons it has been my ardent wish to see a plan devised on a liberal scale which would have a tendency to spread systematic ideas through all parts of this rising empire, thereby to do away with local attachments and State prejudices, as far as the nature of things would, or indeed, ought to admit, from our national councils. Looking anxiously forward to the accomplishment of so desirable an object as this is (in my estimation), my mind has not been able to contemplate any plan more likely to effect the measure than the establishment of a university in a central part of the United States, to which the youth of fortune and talents from all parts thereof might be sent for the completion of their education in all the branches of polite literature, in arts, and sciences, in acquiring knowledge in the principles of politics and good government, and (as a matter of infinite importance, in my judgment), by associating with each other, and forming friendships in juvenile years, be enabled to free themselves in a proper degree from those local prejudices and habitual jealousies which have just been mentioned, and which when carried to excess are never-failing sources of disquietude to the public mind, and pregnant of mischievous consequences to this country.

Madison, though defeated in his effort to secure the approval of the Constitutional Convention in respect to the establishment of a national university, did not fail, when President, to call the attention of Congress to the subject. In his second annual message he said:

I cannot presume it to be unreasonable to invite your attention to the advantages of superadding to the means of education provided by the several States a seminary of learning instituted by the national legislature, within the limits of their exclusive jurisdiction, the expense of which might be defrayed or reimbursed out of the vacant grounds which have accrued to the nation within those limits. (Annals of Congress, 1810, '11, '13.)*

Various other attempts have been made from time to time to establish a national university. Blackmar says:

In 1796 a proposition was before Congress in the form of a memorial praying for the foundation of a university. (Ex. Doc., 4th Congress, 2d session.)

Again, in 1811 a committee was appointed by Congress to report on the question of the establishment of a seminary of learning by the National Legislature. The committee reported unfavorably, deeming it unconstitutional for the Government to found, endow and control the proposed seminary. (Ex. Doc., 11th Congress, 3d session.)

In 1816 another committee was appointed to consider the same subject, and again the scheme failed. (Ex. Doc., 14th Congress, 2d session.)*

When the disposition of the Smithson fund was under consideration (1838–1846), the subject of founding a national university was fully and freely discussed, and the plan was rejected by Congress.

Again in 1873 the matter was revived by the Hon. J. W. Hoyt, who from that time onward never ceased to labor diligently for a national university. Largely owing to his zeal and activity a committee of 100 was formed, various bills were introduced in Congress and a Senate Committee was created to establish a national university. But Congress always looked on the scheme with suspicion and not one of the various bills offered was ever acted upon by the Senate or House of Representatives.

The trend of opinion has been and is that the Government should not found a national university in the sense suggested by Washington and his followers. The Congress has, however, generously aided technical and higher education by grants of land to States and Territories for educational purposes.

The policy was inaugurated under the general authority of the famous Ordinance of July 13, 1787. Conformably thereto a

* 'The History of Federal and State Aid to Higher Education in the United States,' by Frank W. Blackmar, Ph.D.: Bureau of Education, Contributions to American Educational History, edited by Herbert B. Adams, No. 9, 1890, p. 32.

* Op. cit., pp. 39, 40.

contract was entered into between the Ohio Company and the Board of Treasury of the United States, on the 27th of July, 1787, whereby lot 16 in every township was given for the maintenance of public schools and not more than two complete townships were given perpetually for the purpose of a university, the land to be applied to the purpose by the legislature of the State.*

The most important act, after that of 1787, was that of 1862, granting land for the endowment of colleges for teaching agriculture and the mechanical arts. It is to be noted that by this act the responsibility was thrown entirely upon the States, and that, so far as the administration of the fund was concerned, it was State, not national, education.

The total grants of lands aggregate about 13,000,000 acres, or 20,000 square miles. Of this 2,500,000 acres, or 4,000 square miles, were for the establishment of higher institutions of learning. This land, divided among thirty States and Territories, gives an average of a little more than 80,000 acres, or about 130 square miles. For technical schools, called 'Colleges for the benefit of agriculture and the mechanical arts,' Congress has granted to forty-five States 10,500,000 acres, or about 16,000 square miles. This is an average of 230,000 acres, or about 360 square miles. Congress now grants annually to each of the forty-five States $25,000,† a total of more than a million dollars, all of which is expended under the direction of State boards.

The Government maintains, and has maintained since 1802, an academy for training its army officers; also, since 1845, an academy for training its naval officers. The Government does not maintain and never has maintained any institution for training its civil officers.

The policy of the Government, as gathered from its acts, has been to relegate the direct control of education to the States, aiding them in this work by grants of land, and in the case of technical education by grants of money also.

PRESENT POLICY OF THE GOVERNMENT.

Turning, now, to the question, What is the present policy of the Government? we have just seen that aid is given by grants of land, and in the case of the experiment stations by grants of money. As to the use of its literary and scientific collections by students its policy was defined by a public resolution of Congress approved April 12, 1892, which reads as follows:

Whereas large collections illustrative of the various arts and sciences and facilitating literary and scientific research have been accumulated by the action of Congress through a series of years at the national capital; and

Whereas it was the original purpose of the Government thereby to promote research and the diffusion of knowledge, and it is now the settled policy and present practice of those charged with the care of these collections specially to encourage students who devote their time to the investigation and study of any branch of knowledge by allowing to them all proper use thereof; and

Whereas it is represented that the enumeration of these facilities and the formal statement of this policy will encourage the establishment and endowment of institutions of learning at the seat of Government, and promote the work of education by attracting students to avail themselves of the advantages aforesaid under the direction of competent instructors: Therefore,

Resolved, by the Senate and House of Representatives of the United States of America, in Congress assembled, That the facilities for research and illustration in the following and any other Governmental collections now existing or hereafter to be established in the city of Washington for the promotion of knowledge shall be accessible, under such rules and restrictions as the officers in charge of each collection may prescribe, subject to such authority as is now or may hereafter

* Bancroft, 'History of the Constitution,' N. Y., 1882, Vol. II., pp. 435, 436. Also Geo. B. Germann, 'National Legislation concerning Education,' New York, 1899, pp. 19, 20.

† Act approved August 30, 1890. Statutes at Large, Vol. 26, p. 417.

be permitted by law, to the scientific investigators and to students of any institution of higher education now incorporated or hereafter to be incorporated under the laws of Congress or the District of Columbia, to wit:

One. Of the Library of Congress.
Two. Of the National Museum.
Three. Of the Patent Office.
Four. Of the Bureau of Education.
Five. Of the Bureau of Ethnology.
Six. Of the Army Medical Museum.
Seven. Of the Department of Agriculture.
Eight. Of the Fish Commission.
Nine. Of the Botanic Gardens.
Ten. Of the Coast and Geodetic Survey.
Eleven. Of the Geological Survey.
Twelve. Of the Naval Observatory.

The privileges of this act, it will be noted, are limited to scientific investigators and students of institutions incorporated under the laws of Congress or the District of Columbia. This limitation was removed by an act approved March 3, 1901, which reads as follows:

Joint resolution to facilitate the utilization of the Government Departments for the purposes of research, in extension of the policy enunciated by Congress in the joint resolution approved April 12, 1892.

WHEREAS * * *

Resolved, That facilities for study and research in the Government departments, the Library of Congress, the National Museum, the Zoological Park, the Bureau of Enthnology, the Fish Commission, the Botanic Gardens and similar institutions hereafter established shall be afforded to scientific investigators and to duly qualified individual students, and graduates of institutions of learning in the several States and Territories, as well as in the District of Columbia, under such rules and restrictions as the heads of the departments and bureaus mentioned may prescribe.

DISCUSSION AND ACTION IN RECENT YEARS.

Dr. Daniel C. Gilman, in 1897, summarized the situation in relation to the establishment of a national university, as follows:*

First, there is a strong desire, not only among the residents of the Federal city, but among the lovers and promoters of learning throughout the country, that the libraries, collections, instruments, and apparatus belonging to the Government should be opened to students, not as a favor, nor by exception, nor as a passing entertainment, but for study and experiment, according to suitable regulations, and especially under the guidance of such able teachers as may be already engaged in the service of the Government, or may be enlisted hereafter for the particular offices of education. So far as this there would be a unanimous, or nearly unanimous, assent.

Second, the universities existing in Washington and near to it, including those of New England, would regard with disfavor, and probably with distrust, an effort to establish, by congressional action, the University of the United States. In some places there would be positive opposition. * * *

Third, outside of academic circles, as well as inside, there is a great distrust of the principle that Congress should provide for and direct university education. The fears may be foolish. It is easy to laugh at them. Apprehensions may be pronounced groundless; nevertheless it will be difficult to get rid of them. There will be an ever-present expectation of political interference, first in the governing body, then in the faculty, and finally in the subjects and methods of instruction. It is true that partisan entanglement may be avoided, but it will be difficult indeed to escape the thraldom.

In the same article it is suggested that the Smithsonian Institution take charge, so that—

The literary and scientific institutions of Washington may be associated and correlated so far, and so far only, as relates to the instruction and assistance, under proper restrictions, of qualified students. * * * Such a learned society may be developed more readily around the Smithsonian Institution, with less friction, less expense, less peril, and with the prospect of more permanent and widespread advantages to the country, than by a dozen denominational seminaries or one colossal University of the United States.

In February, 1899, Dr. William H. Dall, of the Geological Survey, outlined very clearly the conditions and possibilities for post-graduate work in Washington, and urged that if any organization was attempted it should be free from Government control.*

Little, if any, advantage was taken of the congressional resolution of 1892, which restricted opportunities for study and re-

* *Century Magazine*, November, 1897.

* *American Naturalist*, Vol. 33, pp. 97–107.

search to the educational organizations of the District of Columbia, but with the recent rapid growth of the Department of Agriculture, a considerable number of students have been given opportunity for study and practical training. Secretary Wilson has taken the lead in actually bringing qualified students into the laboratories of a Government department and setting them to work. He has inaugurated a new class, called 'student assistants,' and has demonstrated its practical value. In his report for 1898 he says:*

> George Washington, by his will, left property to be devoted to university education in the District of Columbia. There is no university in the land where the young farmer may pursue post-graduate studies in all the sciences relating to production. The scientific divisions of the Department of Agriculture can, to some extent, provide post-graduate facilities. Our chiefs of division are very proficient in their lines; our apparatus the best obtainable; our libraries the most complete of any in the nation. We can direct the studies of a few bright young people in each division, and when the department requires help, as it often does, these young scientists will be obtainable.
>
> They should be graduates of agricultural colleges and come to the Department of Agriculture through a system of examination that would bring the best and be fair to all applicants. The capacity of the department is limited, but something can be done that will indicate to Congress the value of the plan. The department often needs assistants to take the place of those who are tempted to accept higher salaries in State institutions. The opening of our laboratories to post-graduate work would provide an eligible list from which to fill vacancies as they occur, supply temporary agents, and be a source from which State institutions might get assistance in scientific lines.

The Department of Agriculture naturally turns to the professedly agricultural colleges for its student assistants, but if other institutions gave their students such instruction as would qualify them for the work of that department, there seems to be no good reason why they should be discriminated against.

* 'Yearbook of the Department of Agriculture,' 1898, pp. 18, 19.

As the development of the work progressed in the scientific bureaus, it became impossible to find men qualified for the permanent positions open to them. Graduate students were obtainable, but they were without practical training for the work. The Civil Service Commission was called on, but it had no eligibles on its lists. The only way out of the difficulty seemed to be for the heads of the scientific bureaus to select bright, well-educated young men and train them; this they have been doing for several years. In the Geological Survey graduate students, being the best men available for temporary field assistants in both geologic and topographic work, are given preference. The Survey cooperates with such institutions of learning as are willing to give the advanced instruction necessary to fit students to engage in the several special lines of investigation. This cooperation consists mainly in the employment of graduate students and instructors. A high standard is maintained by the character of the examinations held for selecting temporary employés. For example, in the examination for temporary geologic assistants held April 23 and 24, 1901, the applicants were obliged to meet the following requirements:

> First. To write an essay of more than a thousand words, setting forth either the course and results of an original geologic investigation by the applicant or the main features of the geology of some State.
>
> Second. To answer satisfactorily seven questions, so selected as to test the applicant's knowledge of the science of geology in general.
>
> Third. To select one of the five specialties, stratigraphy, petrography, paleontology, physiography, and glaciology, and make clear the possession of an adequate knowledge thereof.

The weight given to the various subjects was as follows:

Geological essay, including composition and drawing	30 per cent.
General geology	15 per cent.
Special geology	25 per cent.
Education and experience	30 per cent.

Fifty-two persons took this examination, and of these forty-six made an average of more than 70 per cent. The successful applicants have received degrees for academic and graduate study from the following institutions of learning:

Harvard University	13
Johns Hopkins University	6
University of Chicago	6
Yale University	5
Cornell University	4
University of Wisconsin	2
University of California	2
University of Kansas	2
Stanford University	2
Iowa State College	2
Amherst College	2
Munich	2
Alfred University	1
Beloit College	1
Columbia University	1
Columbian University	1
Cornell College, Iowa	1
Denison University	1
Gates College	1
German Wallace College	1
Hamilton College	1
Heidelberg College, Ohio	1
Heidelberg, Germany	1
Indiana State University	1
Lafayette College	1
Lawrence Scientific School	1
Moore's Hill College	1
Ohio Wesleyan University	1
University of Illinois	1
University of Minnesota	1
University of Missouri	1
University of Nebraska	1
University of the City of New York	1
University of Oregon	1
University of South Carolina	1
Williams College	1

The total of forty-six successful applicants divides by State residence as follows:

Massachusetts	9
Illinois	7
New York	7
Iowa	3
Connecticut	2
Indiana	2
Missouri	2
Pennsylvania	2
South Carolina	2
California	1
Colorado	1
Kansas	1
Kentucky	1
New Jersey	1
Ohio	1
Oregon	1
Tennessee	1
Wisconsin	1
Wyoming	1

Of those who passed, forty have received appointments to temporary positions. It is probable that 50 per cent. of the number will become permanent members of the Survey; 38 per cent. already hold or will obtain positions as instructors in educational institutions, and the others will enter State surveys and private employment.

Of the temporary geologic force of the Survey other than those mentioned, and who receive pay only when actually employed, the majority are connected with institutions of learning, as follows:

Harvard University	4
University of Chicago	4
University of Wisconsin	3
Columbia University	2
Stanford University	2
Yale University	2
Amherst College	1
Clark University	1
Colby University	1
Johns Hopkins University	1
Ohio State University	1
University of Michigan	1
University of California	1
University of Virginia	1
University of West Virginia	1
University of South Dakota	1
Vanderbilt University	1
Williams College	1

The preceding statements illustrate the intimate relation existing between one division of one bureau of one department of the Government and the higher educational interests of the country. A close analysis of the personnel of other bureaus will doubtless show that the Government is thus indirectly doing a great work in fostering higher education and research, and it will

at the same time be seen that the educational institutions of the country are training men and women for the highest scientific and technical positions in the Government service.

The Association of Agricultural Colleges and Experiment Stations several years ago realized the importance of giving its students the training which would enable them to meet the conditions prevailing in Washington. A committee of graduate study in Washington was appointed in July, 1897.* In the following April this committee met in Washington to study the conditions under which work might be undertaken. In a report made in November, 1898, the committee said in part:

> After long deliberation and full discussion your committee are unanimously of the opinion that the time is ripe for expeditious action.
>
> The inquiries and investigations so far made lead the committee to the conclusion that it is entirely practicable to provide for the use of the Library of Congress and the collections of the Smithsonian Institution, the National Museum, and of the various scientific and other bureaus in the several departments of the general government, by graduate students of the land grant and other colleges, for study and research, and that it is also practicable to organize, coördinate, and direct such work so as to make it eminently effective.
>
> * *Resolved*, That a committee of five be appointed by the President to investigate, consider, and, if practicable, devise a plan whereby graduate students of the land grant and other colleges may have access to and the use of the Congressional Library and the collections in the Smithsonian Institution, the National Museum, and the scientific bureaus of the various departments at Washington of the United States Government for the purposes of study and research, said plan to include suggestions as to the manner in which such work may be organized, coordinated, and directed to the best advantage; the composition and organization of such a staff as may be necessary to properly coordinate and direct such work, and also an outline of such legislation as may be necessary to effect the general purposes of this resolution. (Proc. Twelfth Annual Convention of the Assn. Amer. Agricultural Colleges and Experiment Stations, held at Wash., D. C., Nov. 15-17, 1898, being Bull. 65, Dept. Agriculture, p. 58.)
>
> The committee has been greatly desirous that some existing agency be found to undertake such work of organization, coordination, and direction, and have naturally turned to the Smithsonian Institution as the one best fitted for the purpose.
>
> The committee is unable, at the present time, to present a complete outline of the legislation necessary to effect the general purposes of the resolution. It submits tentatively, however, that Congress might be asked to provide for the establishment of an administrative office in Washington, preferably in the Smithsonian Institution, in which graduate students of the institutions we represent, and others as well, might be enrolled and directed to the appropriate departments (Bull. 65, Dept. Agriculture, pp. 61, 62).

In a report by the subcommittee of the committee of the National Educational Association on the establishment of a national university, we find that the active cooperation of the Smithsonian Institution is contemplated in the conduct of the proposed school or bureau, but that the committee of the regents of the Smithsonian Institution feel that the powers of the institution, as at present organized, are insufficient to embrace the work proposed.*

At a meeting of the Smithsonian regents held on January 24, 1900, Dr. Alexander Graham Bell introduced a resolution to the effect that Congress be asked to provide for an assistant secretary of the Smithsonian Institution in charge of research in the Government departments, etc. The resolution was referred to a committee, which, on January 23, 1901, reported a modified form of the original resolution. This modified form was adopted by the board of regents. It reads as follows:

> In order to facilitate the utilization of the Government departments for the purpose of research, in extension of the policy enunciated by Congress in the Joint Resolution approved April 12, 1892:
>
> *Resolved*, That it is the sense of the board that it is desirable that Congress extend this resolution so as to afford facilities for study to all properly qualified students or graduates of universities, other than those mentioned in the resolution, and provide for the appointment of an officer whose duty it shall be to as-

* Science, N. S., Vol. XI., March 16, 1900, pp. 410-414.

certain and make known what facilities for research exist in the Government departments, and arrange with the heads of the departments, and with the officers in charge of the Government collections, on terms satisfactory to them, rules and regulations under which suitably qualified persons might have access to these collections for the purpose of research with due regard to the needs and requirements of the work of the Government; and that it should also be his duty to direct, in a manner satisfactory to the heads of such departments and officers in charge, the researches of such persons into lines which will promote the interests of the Government and the development of the natural resources, agriculture, manufactures and commerce of the country, and (generally) promote the progress of science and the useful arts, and the increase and diffusion of knowledge among men.

This resolution referred the matter to Congress. Many members of both Houses doubt whether Congress has power under the Constitution to appropriate money raised by taxation for purposes of education, and nothing was done by Congress, as the resolution was not officially brought before it.

ORGANIZATION OF THE WASHINGTON MEMORIAL INSTITUTION.

At this point the Washington Academy of Sciences undertook to give the proposition to utilize the resources of the Government for higher education and research a practical form, independent of direct Government support or control. For several months the Academy had been conferring with the George Washington Memorial Association relative to erecting in Washington a memorial building to be dedicated to science, literature and the liberal arts. The president of the Academy suggested to the Memorial Association that it should so amend its act of incorporation that it could cooperate with the Academy in carrying out the objects common to both organizations. The suggested amendments were made, and an agreement was entered into substantially as follows:

The objects of the George Washington Memorial Association are, first, as implied in its name, the creation of a memorial to George Washington; and second, as stated in its amended act of incorporation, the increase in the city of Washington of opportunities and facilities for higher education, as recommended by George Washington in his various annual messages to Congress, notably the first—*i. e.*, 'the promotion of science and literature,' substantially as set forth in his last will, and by and through such other plans and methods as may be necessary or suitable. The object of the Washington Academy of Sciences, the federated head of the scientific societies of Washington, is the promotion of science, the term 'science' being used in its general sense—'knowledge, comprehension of facts and principles.'

The two organizations agreed, first, that, although American universities have so developed since George Washington's time that they fulfill many of the objects of the national university outlined by him as desirable for the youth of the United States, there is still need of an organization in the city of Washington which shall facilitate the utilization of the various scientific and other resources of the Government for purposes of research, thus cooperating with all universities, colleges and individuals in giving to men and women the practical post-graduate training which cannot be obtained elsewhere in the United States and which is now available only to a limited degree in the city of Washington, and, second, that the best method of securing the objects for which both organizations stand is the establishment, within the district selected by Washington as a site for the permanent seat of Government of the United States, of an institution whose object shall be the realization of Washington's repeatedly expressed wish and recommendation that provision be made for the *promotion of science and literature.*

The membership of the Academy in-

cludes most of the leading scientific men of Washington and the country at large. The Academy, familiar with conditions in Washington and with the efforts of the committees of the Association of Agricultural Colleges and Experiment Stations and the National Educational Association, and knowing that the Smithsonian Institution would not, under its limitations, take an active part, realized that the time was opportune for a new organization. Its committee drafted and secured the passage of the act of Congress approved March 3, 1901. The committee next drafted a plan of organization, which was accepted by the Academy and Memorial Association. The plan was, in brief, as follows:

1. *Organization.*—A private foundation independent of Government support or control.

2. *Objects.*—(*a*) To facilitate the use of the scientific and other resources of the Government for research.

(*b*) To cooperate with universities, colleges and individuals in securing to properly qualified persons opportunities for advanced study and research.

3. *Government.*—The policy, control and management to vest in a board of fifteen trustees, and in addition there shall be an advisory board composed chiefly of heads of executive departments, bureaus, etc.

Articles of incorporation were then drawn up and executed, and were filed on May 20, 1901. They read as follows:

Articles of Incorporation, Washington Memorial Institution.

We, the undersigned, persons of full age and citizens of the United States, and a majority of whom are citizens of the District of Columbia, being *desirous to establish* and maintain, in the city of Washington, an institution in memory of George Washington, for promoting science and literature, *do hereby associate ourselves* as a body corporate, for said purpose, under the general incorporation acts of the Congress of the United States enacted for the District of Columbia; *and we do hereby certify* in pursuance of said act as follows:

First. The name or title by which such institution shall be known in law is the Washington Memorial Institution.

Second. The term for which said institution is organized is nine hundred and ninety-nine years.

Third. The particular *business and objects* of the institution are: to create a memorial to George Washington, to promote science and literature, to provide opportunities and facilities for higher learning, and to facilitate the utilization of the scientific and other resources of the Government for purposes of research and higher education.

Fourth. The *number of its trustees* for the first year of its existence shall be fifteen.

In testimony whereof we have hereto set our names and affixed our seals, at the city of Washington, in the District of Columbia, on the 16th day of May, 1901.

Daniel C. Gilman.	[seal.]
Charlotte Everett Hopkins.	[seal.]
C. Hart Merriam.	[seal.]
George M. Sternberg.	[seal.]
Chas. D. Walcott.	[seal.]
Carroll D. Wright.	[seal.]

District of Columbia, *ss:*

Be it remembered that on this 16th day of May, A.D. 1901, before the subscriber personally appeared the above-named Daniel C. Gilman, Charlotte Everett Hopkins, C. Hart Merriam, Geo. M. Sternberg, Chas. D. Walcott, and Carroll D. Wright, to me personally known and known to me to be the persons whose names are subscribed to the foregoing instrument of writing, and severally and personally acknowledged the same to be their act and deed for the uses and purposes therein set forth.

Given under my hand and official seal the day and year above written.

[seal.] (Signed) Herbert W. Gill,
Notary Public.

On May 27 fifteen trustees were elected, and on June 3 the officers for the first year were chosen. Lists of these are given herewith:

Board of Trustees, Washington Memorial Institution.

1. Dr. Edwin A. Alderman, President Tulane University.

2. Dr. A. Graham Bell, Regent Smithsonian Institution.

3. Dr. Nicholas Murray Butler, Professor of Philosophy and Education, Columbia University.

4. Dr. C. W. Dabney, President University of Tennessee.

5. Dr. D. C. Gilman, President Johns Hopkins University.

6. Dr. A. T. Hadley, President Yale University.

7. Dr. William R. Harper, President University of Chicago.

8. Mrs. Phœbe A. Hearst, Regent University of California.

9. Mrs. Archibald Hopkins, President George Washington Memorial Association.

10. Dr. C. Hart Merriam, Chief United States Biological Survey.

11. Dr. Cyrus Northrop, President University of Minnesota.

12. Dr. H. S. Pritchett, President Massachusetts Institute of Technology.

13. Dr. George M. Sternberg, Surgeon-General United States Army.

14. Hon. Charles D. Walcott, President Washington Academy of Sciences, and Director United States Geological Survey.

15. Hon. Carroll D. Wright, Commissioner of Labor.

Officers of Washington Memorial Institution.

Daniel C. Gilman, director.
Charles D. Walcott, president board of trustees.
Nicholas Murray Butler, secretary board of trustees.
C. J. Bell, treasurer.

An advisory board also was selected, as follows:

President of the United States.
Chief Justice of the United States.
Secretary of State.
Secretary of the Treasury.
Secretary of War.
Secretary of the Navy.
Secretary of the Interior.
Secretary of Agriculture.
Postmaster-General.
Attorney-General.
Secretary of the Smithsonian Institution.
Commissioner of Education.
Librarian of Congress.
Commissioner of Labor.
Commissioner of Fish and Fisheries.
President of the Civil Service Commission.
President of the National Academy of Sciences.
President of the National Educational Association.
President of the Association of American Universities.
President of the Association of Agricultural Colleges and Experiment Stations.
Dr. Charles W. Eliot.

The duties of the director, as defined in the by-laws are as follows:

The director shall be the chief executive of the institution, and, under the guidance and control of the executive committee, shall conduct its affairs. He shall make all arrangements for cooperation between the institution, on the one hand, and the Government, universities, colleges, learned societies, and individuals on the other, subject to the approval of the executive committee.

EXISTING FACILITIES FOR STUDY AND RESEARCH.

The policy of the Government, as expressed, is to aid in higher education and research by granting the use of such facilities as are at its command in the District of Columbia. The direct control of higher education has been relegated to the States, the Government aiding by grants of land, and in the case of technical education at agricultural experiment stations by grants of money.

The Government has carried on original research for its own purposes in the District of Columbia through grants of money to its various scientific and technical bureaus, notably those of the Department of Agriculture, the Coast and Geodetic Survey, the Geological Survey, the National Museum, the Bureau of Ethnology, the Fish Commission, the Bureau of Education, the Library of Congress, etc.

Of the total sum appropriated for the fiscal year 1901, at least 25 per cent., or $2,020,000, may be regarded as expendable for scientific and research work and in the interest of higher education. The appropriations for the year are as follows:

Department of Agriculture:		
Weather Bureau	$1,168,320	
Bureau of Animal Industry	1,154,030	
" " Plant Industry	204,680	
" " Forestry	185,440	
" " Chemistry	35,800	
" " Soils	109,140	
Division of Entomology	36,200	
" " Biological Survey	32,800	
Agricultural Experiment Stations	789,000	
Miscellaneous	222,000	
		$3,937,410.00
War Department:		
Army Medical Museum and Library		25,000.00
Navy Department:		
Hydrographic Office	$136,518.00	
Naval Observatory	226,461.08	
Nautical Almanac	15,900.00	
		378,879.08

Interior Department:		
Geological Survey	$1,023,423.11	
Bureau of Education	59,370.00	
		1,082,793.11
Treasury Department:		
Coast and Geodetic Survey	$830,345	
Bureau of Standards	167,140	
Marine Hospital	71,100	
		1,068,585.00
Smithsonian Institution:		
National Museum	$289,400	
Bureau of American Ethnology	50,000	
National Zoological Park	80,000	
Astrophysical Observatory	12,000	
International Exchanges	24,000	
		455,400.00
Commission of Fish and Fisheries		543,120.00
Botanic Gardens		24,393.75
Library of Congress		565,345.00
Total		$3,080,925.94

This is about ten cents per capita for the entire population.

Great collections of books, specimens, statuary, paintings, instruments, apparatus, etc., have been assembled in Washington.

Libraries.—Statistics of the principal libraries reveal the presence of a large number of books, maps and pamphlets, many collections of which are exceptionally complete in special lines of research, notably those of the Departments of State and Agriculture, the Geological Survey, the Naval Observatory, the Surgeon-General's Office, the Bureau of Education, the Museum of Hygiene, the Patent Office, the National Museum, and special collections in the Library of Congress. The principal libraries are here listed:

	Books.	*Pamphlets.*	*Maps.*
Library of Congress	1,000,000*		55,700
" " Smithsonian Institution	250,000†		
" " U. S. Supreme Court	80,000†		
" " Army Medical Museum.	135,058	229,546	
" " Dept. of Agriculture	68,000		
" " Bureau of Education	81,872	140,004	
" " Patent Office	74,140		
" " Department of State	63,000	2,500	
" " Geological Survey	47,600	77,027	29,185
" " National Museum	25,000	30,000	
" " Coast and Geodetic Sur.	16,405	6,178	25,000
" " Weather Bureau	18,000	5,000	
" " Museum of Hygiene	11,969		
Library of Hydrographic Office	3,000		
" " Bureau of Ethnology	12,000	4,000	
" " Bureau of Statistics	6,000	5,000	
" " Department of Justice	30,000		
" " Department of Labor	7,051	4,454	
" " Corcoran Gallery of Art	2,500		
" " Treasury Department	22,000	3,000	
" " War Department	49,000	2,000	
" " Navy Department	33,635		
" " Interior Department	15,000		
" " Post Office Department.	12,000		
" " Light-House Board	5,000		
" " War Records Office	2,000		
" " Naval Observatory	20,000	4,000	
" " Naut. Almanac Office	2,200	2,500	
	2,092,430	515,209	109,885

* Books and pamphlets.

† These figures are included in the 1,000,000 assigned to the Library of Congress.

Other libraries in the District bring the grand total to more than 2,500,000 volumes, 570,000 pamphlets, and 110,000 maps, assembled in large part by specialists in every field. All the libraries are accessible and are maintained at a high standard of efficiency.

Collections.—The collections of the National Museum, though inadequately housed and with insufficient laboratories for the work of the regular museum force, are, nevertheless, of such character and are so arranged for exhibition and study that they will be of great service to all who may wish to use them. Under the present organization of the museum there are three departments: Anthropology, Biology and Geology. All the exhibits are systematically classified and placed in immediate charge of specialists acquainted with the results of man's activity in almost every form in which such results admit of study and representative exhibition. As provided by statute, the collections made by the Geological and other surveys are deposited in the National Museum after they have been used by the organization which collected them. This has resulted in an immense accumulation of material, much of which has not yet been fully studied, and upon which, when sufficient laboratory space is provided, students can be employed under the oversight of the specialists in charge.

The collections of the Army Medical Museum have a world-wide reputation and contain a great quantity of unique and valuable material. There are large collections of living animals at the Zoological Park; and there is a fine series, illustrating fish culture, at the Fish Commission building. The museum of the Agricultural Department contains valuable material, especially the working collections of the different divisions, and the Botanic Gardens are capable of great development under scientific direction. To the student interested in the development of American inventive genius and the industries represented by patents the collection of models and drawings in the Patent Office offers exceptional opportunities. Mention should also be made of the collections of apparatus of various kinds in Government laboratories, and of the illustrations of the evolution of apparatus in the National Museum and Smithsonian Institution.

In art, while the collections are not so large as in other lines, yet there is a collection of excellent quality in the Corcoran Gallery of Art, which maintains a free school. In this school day and night classes are taught the arts of drawing and painting, free of tuition fees or charge of any kind. Up to the close of 1899, 844 pupils had received instruction in the day school and 1,483 in the night school.

The Naval Observatory has a good equipment, including a chart and a chronometer depot, an extensive collection of instruments used in taking astronomic photographs, a fine telescope and transit instruments used in carrying on its routine work.

The newly created National Bureau of Standards is to have buildings and a fine equipment of all necessary apparatus. When fully developed it will be second to none in the character and value of its scientific and practical work. The functions of this bureau are defined in the organic act as follows:

> The functions of the bureau shall consist in the custody of the standards; the comparison of the standards used in scientific investigations, engineering, manufacturing, commerce and educational institutions with the standards adopted or recognized by the Government; the construction, when necessary, of standards, their multiples and subdivisions; the testing and calibration of standard measuring apparatus; the solutions of problems which arise in connection with standards; the determination of physical constants and the properties of materials, when such data are of great importance to scientific or manufacturing interests and are not to be obtained of sufficient accuracy elsewhere.

Law and Diplomacy.—The State Department has accumulated a valuable library relating to international law. The law library of Congress contains more than 50,000 volumes exclusively legal in character, and accommodations are provided for students who wish to use it. The School of Diplomacy of Columbian University is one of the unique features of the educational organizations of Washington. The Supreme Court of the United States and the Court of Claims bring together the foremost American lawyers. There is also the Supreme Court of the District of Columbia, which has the common-law, equity, and probate jurisdiction of State courts, besides that of the circuit and district courts of the United States.

There are, of course, unequaled opportunities for studying the development of legislation and for meeting the leading statesmen and public men of the country.

Medicine.—The Army Medical Museum has one of the finest collections in existence of recent pathologic specimens. These, taken with the library of the Surgeon-General's Office, in the same building, afford a rare opportunity for the medical student. In the adjoining National Museum there is a most complete collection illustrating the *materia medica* of the United States and of foreign countries. There are also several

hospitals, at each of which clinical instruction is given.

Congress has enacted that these vast collections and resources shall be available for higher education and research, but it has not provided the machinery for making them practically available. As in the case of the grants of land to colleges, Congress provides facilities and indirectly the means, but it leaves to other agencies the task of devising ways and means to make them practically useful.

The Government is obliged to train most of its specialists. Opportunities for post-graduate study and research exist at a few of the strongest universities, colleges and technical schools of the country, but at best the training given, except in a few branches, is of a preparatory character. Most American youth who are ambitious to pursue higher study and research have little opportunity, owing largely to the fact that the instructor's duties leave him scarcely any time for research and practical work with the student. Post-graduate students seek instructors distinguished for research, even to the extent of undergoing many privations and leaving their country. In the city of Washington the Government has assembled the largest body of original investigators to be found in any one place in the world. Most of these investigators are willing to train suitably qualified students, because of the assistance the students can give them in the work they have in charge, the method being to have the students do actual, practical work, and not to instruct them in the ordinary sense of the word. An unofficial inquiry indicates the following as a possible number of instructors and students in the various departments and bureaus at Washington:

	Instructors.	*Students.*
1. History and diplomacy	1	5
2. Historical research	5	10
3. Library administration and methods	5	15
4. Statistics	2	5
5. Magnetism	1	2
6. Meteorology	5	15
7. Tides	1	2
8. National Standards (Bureau of)	....	....
9. Astronomy	3	8
10. Physics	2	3
11. Hydrography	5	10
12. Cartography, etc.	2	5
13. Topography	10	20
14. Chemistry	6	10
15. Mineral resources	1	5
16. Geology	10	17
17. Paleontology	5	7
18. Animal industry	10	25
19. Anthropology and ethnology	4	13
20. Zoology	34	50
21. Botany	11	25
22. Forestry	10	20
	133	272

With the development of a well-considered plan, just alike to the student and to the officers of the Government, the number of students—or, more strictly speaking, student assistants—would increase from year to year. Most of the students would naturally come from institutions of learning; in all such cases the student should be certified to the director of the Washington Memorial Institution, and finally certified back to the parent institution after completing his work, such certificate to be based on the work done and the proficiency made. In the case of individual students not connected with any institution, let each prove his capacity to profit by the opportunities, and then accredit him to the special officer who has charge of the field of work in which he may wish to study; on satisfactory completion of the work undertaken, the certificate of the Washington Memorial Institution might be addressed '*To whomsoever it may concern.*' Students working in Government laboratories, museums and libraries would be subject to the rules obtaining therein.

It is the belief of many acquainted with the educational system of the country that

the policy above outlined will result in a body of trained students, ready for expert work, many of whom will undoubtedly enter the government service, while others will become instructors in institutions of learning or be engaged as experts in private capacity. This will avoid competition with other institutions, will give most valuable training and practical experience to students, and will be especially helpful to instructors in educational institutions, who might wisely be sent for six months or a year to Washington, as at present some are sent abroad. There should be no thought of providing a general or liberal course of education. Coming as student assistants, there should be opportunities and encouragement only on clearly defined lines of study and investigation. There are many large and small problems to be worked out by the officers of the Washington Memorial Institution, but with the skilled educator and organizer now at its head as director their successful solution is only a matter of time. It is anticipated that the Washington Memorial Institution will, under the direction of Dr. Gilman, begin its work by November 1, 1901.

The Government's part in the work, when once under successful headway, will be to enlarge the quarters of the various bureaus concerned. This will be necessary eventually even if no student assistants are provided for. The Government has done its part nobly so far. It is now for the educational institutions of the country to come forward and assist by setting a high standard of scholarship for admission to the privilege of becoming a student assistant in the Government bureaus. Only students of the type of those who win fellowships or excel in ability should be certified or accepted.

The Washington Memorial Institution should, and I believe will, maintain a standard that will meet the approval of our colleges and universities. It should occupy a most important place in the great educational work of the country. With the hearty cooperation of our collegiate institutions and of the officers of the Government, there is little question that it will ultimately become the federated head and clearing-house of all the higher educational interests of the country.

The relations of the National Government to higher education and research are intimate and complex; but the complexities are already partially resolved, the present is auspicious, and the future outlook is most promising. Long ago the nation recognized its obligation 'to promote a higher and more extended policy than is embraced in the protection of the temporal interests and political rights of the individual.' The action of Congress in the present year in opening the Government bureaus at Washington for study and research is a long stride forward, and, if carried out in good faith must result in another and higher standard for American endeavor.

CHARLES D. WALCOTT.
U. S. GEOLOGICAL SURVEY.

THE ROYAL SOCIETY OF CANADA.

THE twentieth general meeting of the Royal Society of Canada was held in Ottawa, May 21, 22 and 23, 1901. This is essentially a national institution. It was founded in 1882 by the Marquis of Lorne, now His Grace the Duke of Argyll. The Society is divided into *four* sections:

I. French Literature, History and allied subjects.
II. English Literature, History and allied subjects.
III. Mathematical, Physical and Chemical Sciences.
IV. Geological and Biological Sciences.

The Society met this year under the presidency of Dr. Louis Honoré Fréchette, C.M.G., who delivered his inaugural address, 'Race and Language Problem in

Canada,' on the evening of Tuesday, May 21, before a large audience. The various sections met for the transaction of business and reading of papers. Delegates from affiliated literary, scientific and historical societies throughout Canada presented their reports and many of them took part in the deliberations of the Society.

The report of Council for 1901, presented by the Honorary Secretary, Sir John George Bourinot, K.C.M.G., historian, besides containing an account of the business affairs of the Society regarding the election of four new fellows, the diplomas of fellowship, the death of the Queen and the accession of King Edward VII., the associated societies and the proposed meeting in Toronto in 1902, dealt a heavy blow upon the circulation of 'yellow' journals of the United States and in general. The question of establishing public libraries, the care of the Dominion archives, the Canadian Marine Biological Station, Nova Scotian and New Brunswick archives, tidal investigations, together with the question of publishing historical memoirs and diaries received attention as well as the question of preservation of places of scenic and historic interest, including the site of Louisbourg and the Plains of Abraham. The report also contained biographical sketches of the late fellows, Hon. F. X. Marchand and Dr. George Mercer Dawson.

In accordance with a suggestion contained in the honorary secretary's report of last year, to prepare a record of Canadian publications embraced under the several sections of the Royal Society, the following committee of Section IV., which was appointed in May, 1900, reported, viz: For geology and paleontology, Dr. H. M. Ami; for general zoology, exclusive of entomology, Dr. J. F. Whiteaves; entomology, Dr. C. J. S. Bethune; botany, Dr. A. H. Mackay. By a resolution of the Section the same committee was reappointed for the year 1901.

Inasmuch as Sections I. and II. are literary and historical and Sections III. and IV. deal with the *sciences* mathematical, physical, chemical and natural, the following abstracts of papers read before the last two named sections will be given for the benefit of the readers of Science:

SECTION III.—MATHEMATICAL, PHYSICAL AND CHEMICAL SCIENCES.

Presidential Address: *A Century of Progress in Acoustics:* President Loudon, of the University of Toronto.

The Principles at the Base of Quaternion Analysis: Professor Alfred Baker, M.A., of the University of Toronto.

Note on the Basic Chlorides of Lead, Antimony and Copper: Professor W. Lash Miller, Ph.D., of the University of Toronto, and Mr. F. B. Kenrick, Ph.D.

A method of ascertaining whether the precipitate produced in a salt solution by potash or ammonia is a single chemical compound, a mixture, or a 'solid solution,' with results of experiments.

The Synchronism of Arctic and Antarctic Auroræ: Mr. Arthur Harvey.

Auroral observations of the Belgian Antarctic expedition of 1898. Construction of a table and an auroral curve therefrom; identification of this curve with those for Canada and the United States. Enquiry from Arctowski, meteorologist of the *Belgica*, if other concordances are traceable between Auroræ Australes and Boreales. He entrusts the examination to Canada. Detailed scrutiny of the records of these countries shows the distribution of auroræ to be local and that their character varies at various points. Negative answers must be returned to the questions asked, but close examinations of auroræ in Canada must be made during the several Antarctic expeditions soon to set out.

The Human Machine, the Most Marvelous (as set forth by Dr. Lardner in his Animal Physics, 40 years ago): Mr. C. BAILLARGÉ, C.E., M.A.

On the Occurrence of Free Ammonia in Saline Waters: FRANK T. SHUTT, M.A., F.I.C., F.C.S.

The New Gas from Radium: Professor E. RUTHERFORD B.A. (Cantab.), of McGill University, and Miss H. T. BROOKS.

Discharge of Electricity from Glowing Bodies: Professor E. RUTHERFORD, of McGill University.

SECTION IV.—GEOLOGICAL AND BIOLOGICAL SCIENCES.

Observations on Phenological Records: Presidential Address before the Section by Dr. A. H. MACKAY, Superintendent of Education in Nova Scotia.

In this paper Dr. MacKay referred to the different stations established in Nova Scotia and other portions of Canada where phenological observations were being recorded. The records of the average phænocron of certain well-known species of flowering plants were also discussed, and the best methods of eliminating errors in records.

Sir John W. Dawson—In Memoriam: Professor FRANK D. ADAMS, M.E., Ph.D., (by request of the Royal Society at its meeting in 1900).

This memorial of the first president of the Royal Society of Canada was read by title and ordered to be printed *in extenso* together with Dr. Ami's completed 'List of Writings of Sir William Dawson.'

The Carboniferous Basin in New Brunswick: R. W. ELLS, LL.D., of the Geological Survey of Canada.

The Carboniferous rocks in New Brunswick embrace an area of not far from 12,000 square miles. They occur in a roughly triangular-shaped basin, which extends from the Gulf of St. Lawrence on the east as a base, nearly to the southwest boundary of the province. At a number of points beds of coal are found, but these, in so far as yet examined, are thin, ranging from a very few inches to about two feet in thickness. Borings have been made from time to time for over sixty years to ascertain the presence of thicker or more workable beds, but owing to various causes such attempts have not yet been successful. The greater portion of the area, however, has not yet been proved. The paper will briefly state some of the principal conclusions arrived at regarding the structure of this basin during the last thirty years, and will indicate the relations of the Carboniferous sediments to the rocks of the underlying formations. In the discussion which followed, Dr. Bailey pointed out that the Legislature of New Brunswick had granted a subsidy for the purpose of developing the coal-bearing areas of the Grand Lake District. Dr. Matthew maintained that there was considerable chance of discovering suitable coal seams in New Brunswick, and argued that something should be done to ascertain their possible existence. Dr. Ami stated that within the Carboniferous Basin of New Brunswick he would include the strata called 'fern-ledges,' Lancaster formation or 'Little River Group,' which held a flora and fauna of Carboniferous age.

Notes on Some of the Silurian and Devonian Formations of Eastern Canada, and their Faunas and Floras: H. M. AMI, M.A., D.Sc., F.G.S.

From recent studies carried on by the author, the succession of the sedimentary formations of both the Silurian and the Devonian Systems in Eastern Canada needs revision and elucidation. There are several distinct geological horizons which constitute as many distinct formations that are as yet unplaced and unnamed in the Canadian succession, and a discussion of the relations which exist between the different

formations or members of these systems in different portions of Canada was presented. The subdivision of the Silurian succession at Arisaig, in Antigonish County, Nova Scotia, those of Gaspé, Anticosti and Ontario are included, and are based upon the faunas determined by the late Mr. Billings and Professor Hall, as well as from material in the hands of the author for some years past. The subdivisions of typical Devonian formations are also given. These will form a basis for the classification of the terranes in eastern Canada, according to latest and most approved methods.

Acrothyra and Hyolithes—a comparison. With a description of a new species of Hyolithes: G. F. Matthew, LL.D.

The comparison was made for the purpose of seeing how far the muscular system of one genus corresponds to that of the other. The ventral valve of *Acrothyra* was compared with the tube of *Hyolithes*, and the dorsal valve of the former genus with the operculum of the latter. The *Hyolithes* described is a slender species from the base of the *Paradoxides* bed at St. John.

On some Modes of Occurrence of the Mineral Albertite: Professor L. W. Bailey, LL.D., of New Brunswick University.

Since the closing of the celebrated Albert Mines, in Albert county, New Brunswick, the ownership of which for a time hinged upon the determination of whether the mineral which thence derived its name should be regarded as coal or asphalt—a number of interesting observations have been accumulating which have a direct bearing upon this question. The present paper narrates and discusses some of these observations, and is accompanied by specimens illustrating the occurrence of the mineral with widely different associations, and in rocks of quite different geological horizons, *e. g.*, in Pre-Cambrian slates, in calcareo-bituminous shales, in gray Carboniferous sandstones, in snow alabaster, in admixtures of calcite and pyrite, and cementing crystals of selenite. The vein-like nature of the mineral and its originally fluid or semi-fluid condition are strongly emphasized. In the discussion which followed, Dr. Ells, Dr. Ami and Mr. Poole took part. Dr. Ells places the Albert shales in the Devonian System. Dr. Ami argued for the Eo-Carboniferous age as shown by fish remains and plants.

Jacques-Philippe Cornuti. Notes pour servir à l'histoire des sciences au Canada: Par Mgr. Laflamme.

Cornuti a publié à Paris, en 1635, un volume qui renferme la description d'un bon nombre de plantes canadiennes. Il n'est jamais venu au Canada; ses études ont été faites d'après des échantillons vivant dans le jardin des Robins, à Paris. Le but de cette note est d'abord de rechercher par qui les plantes canadiennes avaient été transportées à Paris, si tôt après la fondation de Québec, et ensuite, d'examiner toutes ces descriptions et de déterminer la synonimie entre la nomenclature de Cornuti et la nomenclature actuelle.

On some Geological Correlations in New Brunswick: Professor Bailey, LL.D., of New Brunswick University.

While the geological age of the rock formations in New Brunswick has in most instances been determined upon satisfactory evidence, much uncertainty has existed regarding certain groups of strata and especially those which, consisting largely of slaty rocks, border the great central granite axis which traverses the central part of the province, in the counties of York, Carleton, Northumberland and Gloucester. For, though regarded originally as Cambrian by Gesner, Robb, Logan, Hind and others, and subsequently colored and described, though only provisionally in the maps and reports of the Geological Survey, as Cambro-

Silurian, the only fossils found therein, at widely separated points, were, with a single exception, where an Ordovician fauna occurs, such as to indicate a much more recent (Silurian or Devonian) horizon. In the investigation of the problems arising from this fact, and in the effort to determine, upon behalf of the Geological Survey, more exact knowledge as to what systems were actually present and their relative limits, the author of this paper was, during the past summer, fortunate in being able to obtain evidence in the discovery of certain graptolitic strata, tending to confirm the original view that large portions of the belts in question are really of Cambrian age, with a probability that other large areas are still older, representing either the Etcheminian formation, so called, of Matthew or the Huronian of other writers. The facts relating to these observations, which have a bearing upon questions of a far-reaching character in relation to Acadian geology, are in this paper briefly summarized and discussed.

On the Subdivisions of the Cambrian System in Canada: H. M. AMI, M.A., D.Sc., F.G.S., of the Geological Survey of Canada.

This paper discusses the various geological formations which naturally fall under the Cambrian system in British North America. An attempt is made to present a systematic table giving the succession of the different faunas of this system and the different formations under which each falls. The main object of this paper is to bring the nomenclature of this system to date with a view of classifying the organic remains comprised within its limits, with a brief discussion as to these limits.

A Backward Step in Paleobotany: G. F. MATTHEW, LL.D.

This is a review of the attempt made to claim the plant beds in the Little River Group and their flora, and so the whole terrane, as Carboniferous. This claim is made on Paleobotanical grounds by Messrs. D. White, R. Kidston and H. M. Ami.

The article recites the stratigraphical and physical objections to this view, and in this connection two sections near St. John are given, showing the relation of this terrane to the lower Carboniferous. The fauna of the plant beds is reviewed, and it is suggested that even from this point of view there is not sufficient evidence to overthrow the result arrived at by those who had previously studied the flora and the stratigraphy. Dr. Bailey, Dr. Ells, Mr. H. S. Poole and Dr. Ami took part in the discussion which followed the reading of this paper. The first three gentlemen brought forth all the arguments possible bearing on the Devonian age of the plant beds in question. Dr. Ami pointed out the synchronism existing between these beds and the Carboniferous strata of other parts of North America and Europe.

Notes on Some Butterflies from Western Canada: Dr. JAMES FLETCHER, Dominion Entomologist.

This paper described interesting captures made in the northwest Territories and the Rocky Mountain region of Canada.

The Avifauna of the Province of Quebec: Sir JAMES M. LEMOINE, Knt. F.R.S.C.

This forms an interesting check-list of the birds of the Province of Quebec.

A Dual Classification required in the Nomenclature of the Geological Formations in Different Systems in Canada: H. M. AMI, of the Geological Survey of Canada.

This paper brings forward the result of special work carried on by the writer during the past fifteen years in the classification of numerous geological formations throughout the Paleozoic Period in Eastern Canada. It has become necessary, in the light of recent investigation, to introduce two parallel columns at least, in the suc-

cession of the geological formations of Ordovician, Silurian, Devonian and even Carboniferous Systems. Tables giving the natural order of succession of the different formations falling under this dual classification accompany the paper.

The Value of Nature Study in Practical Education: Dr. James Fletcher, Dominion Entomologist to the Central Experimental Station at Ottawa.

In his opening remarks Dr. Fletcher said that he was thankful that the educators of the youth in every province of Canada have shown that they keenly appreciate the value of natural history studies as an integral and effective part of a practical education. He would appeal more especially, now, to the educated classes of Canada, amongst whom it must be acknowledged there is an appalling and unnecessary ignorance upon many useful branches of knowledge, some information upon which would make them far better citizens and more efficient competitors in whatever branch of work they may have adopted as the means of obtaining a livelihood. There is no profession, trade or occupation, in which definite or exact knowledge is not daily required with regard to subjects, the consideration of which comes within the scope of some branch of natural science. The last half-decade has seen a bright awakening to the realization of the value of nature studies as a means of cultivating the faculties of the youth of every land where progress is made. To teach the child the beginnings of things, the elements of knowledge through the common things about us, will lead it to want to see, to know and understand, and hence think carefully with a view of drawing right conclusions. The flowers, birds and insects furnish as many and useful objects for the grandest, the simplest and best lessons in educating the youth of our land. Whether they are beneficial or injurious, and why so, will lead the observing student to find out their uses and recognize whether they have or have not as yet been recognized. Sympathy and kindness are the outcome of nature studies, likewise healthful enjoyment. Principles of perfection appear wherever nature has not been interfered with. A perfect method and system is revealed, and well may those entrusted with the education of others turn to these natural models to inculcate those principles so necessary to develop the mind.

Amongst the interesting exhibits shown during the meetings of the Royal Society was a plan of the new museum, known as the 'Victoria Memorial Museum,' to be erected in Ottawa at once. Through the kindness and courtesy of the Honorable Mr. Tarte, Minister of Public Works, the plans were placed on exhibition in the Normal School building where the Royal Society was holding its meetings. The building has a frontage of 322 feet, and is 188 feet deep, with a tower dome in the center. It is intended to accommodate the collections at present stored in the unsafe building occupied by the Geological Survey Department on Sussex Street, Ottawa, comprising minerals, ores, fossils, plants, trees and other natural history objects as specimens illustrating the natural resources of Canada, also the Fishery exhibit now on O'Connor Street, and the paintings in the Art Gallery. A resolution, passed by the Royal Society of Canada and transmitted to the Government of Canada congratulated the latter on its wise action.

On May 22 a resolution was passed approving and supporting Capt. F. Bernier, of Quebec City, who is taking charge of the expedition to the North Pole. An interesting discussion followed in which many Fellows took part, including G. H. Parkin, C.M.G., Sir Sandford Fleming Dr. R. Bell,

F.R.S. and Capt. Bernier himself. It will be remembered that in 1900 the last-named gentleman described his proposed route of travel after having pointed the courses taken by all the previous important expeditions to the North Pole, including Fridtjof Nansen's important last voyage.

The following officers were elected:

President: Principal J. Loudon, LL.D., of Toronto University, Toronto.

Vice-President: Sir James A. Grant, K.C.M.G., M.D., etc., Ottawa.

Hon. Secretary: Sir John G. Bourinot, K.C.M.G., LL.D.

Hon. Treasurer: Dr. James Fletcher, F.L.S.

The following officers of Section IV. (Geology and Biology) were elected for the ensuing year:

President: Professor Frank D. Adams, M.Sc., Ph.D.

Vice-President: Professor T. Wesley Mills, M.D., etc.

Secretary: Mr. G. U. Hay, Ph.B. (St. John, N.B.).

H. M. AMI.

OTTAWA, May 27, 1901.

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*SCIENCE AND THE LONDON UNIVERSITY.**

I.

BY the University of London Act, 1898, and the statutes and regulations framed in pursuance thereof, the long-standing controversy as to the form and organization of the London University was finally disposed of. The various colleges and other institutions doing university work within the metropolitan area have been coordinated under a strong and representative senate, which is charged with the duty of providing, for the six millions of inhabitants within a radius of 30 miles from the University building, every kind of instruction of university type. To enable the reorganized London University to cope with this gigantic task, the Chancellor of the Exchequer frankly confesses his inability to do more than provide the office expenses. If London wants a teaching university, London, says the Chancellor, must pay for it. In the special financial circumstances of the moment this appeal to public-spirited Londoners can scarcely be considered unreasonable.

The task of equipping and endowing a University can never be a small one, and the extent and variety of the needs of London might daunt the munificence even of an American millionaire. Fortunately, we do not have to start quite from the beginning. The organization and constitutional framework are completed and stand ready to start. A large part of the materials for a University worthy even of the capital of the Empire only await the hand of the master builder. What is wanted is, first, a comprehensive survey of the field and an appreciation of the amount and variety of the work to be done. Upon this must follow the motive power of money.

The new university is organized in eight faculties, namely, theology, arts, music, law, medicine, science, engineering and 'economics and political science (including commerce and industry).' But, though provision is thus made for all branches of University study, old and new, it is already clear that London University will have a character of its own. The distinctive note of the University is evidently destined to be that of applied science, or the concrete application to every branch of industrial and social life of the discoveries and laws of the various sciences. It is this side of university organization that we must therefore first consider.

In physical science the London University holds an honorable tradition, as having been the first to create a science degree. At present the University includes three 'schools' of science for men, and two more (Bedford and Halloway) for women only. Of these, the Royal College of Science, fully

* From the London *Times*.

staffed and equipped at the Government expense, is confined practically to science teachers, drawn by scholarships from all parts of the country, and to the mining and metallurgical students of what was formerly the Royal School of Mines. The science schools at University and King's Colleges, directed by able professors, are severely handicapped by inadequate accommodation and limited funds, whilst the high fees necessitated by the absence of endowment exclude all but a small number of students. The total number of undergraduate science students in these five schools may be estimated at six or seven hundred. Cheaper science-teaching at more convenient centers, open in the evening as well as in the daytime, is supplied not only at the admirably organized Finsbury Technical College of the City and Guilds Institute, but also by the dozen so-called 'polytechnics.' These latter have been greatly improved during the last few years. By the aid of large grants from the London County Council, their laboratories and scientific equipment have been brought up to a high university standard, whilst the professional staff has been strengthened by the appointment of men of excellent scientific attainments. A large proportion of London candidates for science degrees are now trained in the polytechnic laboratories, which may probably include, in the aggregate, between two and three hundred science students above matriculation standard. The total number of science students of undergraduate status in the whole six million of people apparently does not reach one thousand. Additional centers of science instruction for undergraduates are required in north west London, Hackney and Hammersmith, whilst in the outer suburbs the existing institutions at Croydon, Tottenham and West Ham need developing up to university standard. With additional professors and enlarged laboratories at these twenty-five science centers, all parts of London would be fairly well served, so far as science instruction up to the B.Sc. degree is concerned; and the number of undergraduate students in the faculty might reasonably be expected to rise to at least 2,000.

But the most serious deficiency in the London faculty of science is not the inadequacy of the instruction for the science degree, but the lack of anything like adequate provision for chemical, physical and biological technology, or the application of science to industrial processes. The munificence of Mr. Ludwig Mond has provided a well-equipped laboratory at the Royal Institution, in which a few highly qualified scientists find the opportunity for pursuing special researches. But of public provision for instruction in scientific technology there is practically none. The same national neglect which lost us the great industry of coal-tar products—positively a British discovery that we failed to utilize and abandoned to Germany—now bids fair to lose us one branch of applied chemistry after another. At the present moment perhaps the most promising outlook in the scientific field is presented by electro-chemistry, including both electrolysis and the multifarious operations of the electric furnace. This new science has already transformed the commercial production of copper and aluminum, and given us such new products as carbide of calcium (for the economical production of acetylene) and carborundum. It bids fair, moreover, to revolutionize the whole alkali industry. Yet beyond certain small experiments, due to personal initiative of two or three professors, London offers no means and no opportunities for instruction and research in the subject. If electro-chemistry is destined to transform the world's industry, it is to Germany, and not to England, that the advantage of the first start seems at present likely to accrue. There is no more press-

ing need in London's University equipment than a special school of electro-chemistry, fully equipped with its necessary expensive apparatus, and provided with an endowed and not overworked staff of professors, able to inspire and direct the studies and researches of a selected band of graduate students. The same deficiency is found in other branches of technology. Mining and metallurgy are provided for on what must be called a small scale at the Royal College of Science, and mineralogy also in two or three small classes elsewhere. But nothing that can be called adequate exists for the technical education, at convenient centers and hours, at low fees, of the swarm of mining and metallurgical engineers that London ought to be sending out to every part of the Empire. It deserves the attention of those who are interested in the great mining enterprises of South and West Africa, America and Australasia, whether the time has not come for the establishment of a distinct school of metallurgy and mining, with special reference, not to coal and iron and the conditions of Great Britain, but to the products and needs of other climes. In applied chemistry, too, beyond the praiseworthy attempt at the Herold's Institute (Bermondsey) to deal with leather dyeing and tanning, practically nothing in the nature of a school of chemical technology exists in the metropolis. London transcends every other city in the magnitude and variety of the local industries depending on one chemical process or another. Besides its large interest in every branch of the clothing trade, in all the materials for construction, and in such specialties as the use of india rubber, London is the greatest center for all the applications of photography and the various lithographic processes still most incompletely taught and studied. It is, moreover, the largest center of gas manufacture, and hence the most extensive producer of coal-tar. At present the valuable by-products of London's gas works are for the most part only so far dealt with on the spot as to reduce the cost of their freight to other parts. Practically all the skilled and remunerative treatment of coal-tar products is left to Germany, to which country we export what is virtually the raw material of a most valuable trade, from sheer lack of scientific knowledge of how to make the most of it. Apparently we are contented with this state of things, seeing that London has to this day no center of instruction in gas manufacture and the treatment of its by-products; nor any provision for systematic research into their possible developments. Even the immemorial London industry of tanning is falling behind. Hides are positively beginning to be exported from England to New York to be tanned in the United States by new processes and sent back as leather to Leicester and Northampton. It is probable that few, if any, investments would, in the largest sense, pay better than the establishment — possibly in east or south London—of a great school of chemical technology; and, if we turn from physics and chemistry to biology, we must notice that, whilst the Institute of Preventive Medicine studies bacteriology from the pathological standpoint, London has as yet no provision for instruction and research in its industrial side. One of the largest and most profitable of London industries depends on the bacteriological process of fermentation. The whole future of London's food supply—to say nothing of its sewage disposal—is involved in the same question; and refrigeration, to name only one out of many applications, is already the nucleus of a great industry. The most economical means of lowering temperature on a large scale, under commercial conditions, has become literally a matter of life or death in certain industries. This knowledge can hardly be 'picked up' at the works or in the office.

Yet there is no institution teaching it. We need to expand our few and scanty classes in zoology and physiology into an organized school of instruction and research into all the biological processes that are or can be applied to industry. We pass to another range of science in mathematics and astronomy; but it is one in which London has a special interest. It seems almost incredible that in the greatest port of the world, providing its own large quota to our mercantile marine, absolutely no public provision exists for instruction in the art of navigation, or in the application of mathematics and astronomy on which the art depends. There is urgent need for the establishment, in connection with the University, preferably in East London, of a school of nautical astronomy and navigation, including the applications of magnetism and meteorology to the sailor's art.

The Science Faculty seems thus to require:

1. Increase in staff of professors and instructors at existing centers—say, £15,000 a year (£500,000).

2. Extensions at existing centers in buildings and equipment to accommodate additional students—say, £80,000.

3. New centers — building, equipment, and endowment of science departments at, say, three at £40,000 (£120,000).

4. New subjects—provision for buildings, equipment, and endowment of centers for electro-chemistry (£100,000), mining and metallurgy (£100,000), technological chemistry (£100,000), bacteriology and biology in its industrial relations (£100,000), nautical astronomy and navigation (£100,000), etc.—total for science, £1,200,000.

SCIENTIFIC BOOKS.

Lehrbuch der vergleichenden mikroskopischen Anatomie der Wirbelthiere. By Dr. Albert Oppel. Dritter Theil. Mundhöhle, Bauschspeicheldrüse und Leber. Jena, Fischer. 1900.

With this volume is completed the discussion of the digestive system. Volume I. comprised the stomach and included 543 pages; Volume II., the esophagus and intestine, in 682 pages. The present volume consists of 1180 pages, with XI. plates and 679 figures in the text, therefore exceeding considerably the preceding volumes in size in accordance with the greater complexity of the parts considered.

The work follows closely the plan of the preceding volumes. Each subdivision is discussed in historical sequence, the statements of the author being included between oblique lines, //. In accordance with the plan, the greatest pains have been taken to show the present state of knowledge of the structure of each part in the different forms, and to this end the search in the literature has been made exhaustive, and references to all papers, however trivial, have been sought out. No prejudice has influenced the writer in favor of continental investigators to the exclusion of others; indeed, the recognition of American work seems to be greater than that accorded by many American writers. The quotation of each author is followed by his name and the year of publication. The complete title is given in a bibliography in the end of the volume.

Where there are differences of interpretation (as, *e.g.*, as to the nature of the demilunes in the mucous salivary glands), the different theories are propounded, weighed and (where possible) some choice is indicated.

The text is followed by a table of animal forms, giving a key to the position of the species considered in the text and an arrangement of their families in systematic order. This is followed by the bibliography of 50 pages, and finally, author and subject indices.

In the body of the work the oral cavity with its adnexa, pancreas and liver are taken up successively. In connection with the oral cavity are discussed: the structure of the mucous membrane in the different classes; the pharynx of mammals; the lymphoid tissue of the oral cavity; the tongue; nerves and sense-organs; and finally, the oral (salivary) glands. The teeth, which on many accounts might seem to be properly included, are omitted to be discussed with the skeletal system in a subsequent volume.

In each of the subdivisions the subject is taken up systematically and in detail. For example: the lymphoid tissue in the oral cavity is discussed (1) as to its significance, (2) the migration of the leucocytes through the epithelium, (3) the structure of the lymphatic nodules, (4) the tonsils (lingual, palatine and pharyngeal), and finally (5) the development of the tonsils. In summarizing the subdivision dealing with the tongue, Oppel arrives at the conclusion that the mammalian tongue is to be derived from the entire tongue of the lower vertebrates and not merely from the back portion of it (as Gegenbaur believed).

Especially in the case of the oral (salivary) glands has there been felt the need of a summarization of knowledge, and Oppel has furnished it admirably. The classification of the mammalian oral glands, their occurrence and structure in the different animals, have been made the subject of varied interpretations—Lavdowsky's, Klein's, Nadler's, Stöhr's and Ranvier's are given.

The interpretation of the demilunes of Giannuzzi of the mucous glands receives full discussion. The three views of the substitution theory, phase theory and special function theory are each presented and criticised. Oppel rejects the first two and considers the third as the one to be accepted in the light of recent work (Krause, Solger, Müller, *et al.*).

The pancreas seems to be of universal occurrence in the vertebrates; wherever it has been sought for it has been found. Comparison with the salivary glands to see whether it can be regarded as an 'abdominal salivary gland' (the German name) shows that there are certain specific structural differences that distinguish it.

The pancreas is discussed from the point of view of the finer structure of the gland cells, including a consideration of the so-called paranucleus, the activity of the cells, the form of the tubules, centro-acinar cells, the terminal ducts and the structure of the pancreatic ducts in the classes of vertebrates, the connective tissue of the gland. The interesting areas of Langerhans are next discussed, and in regard to their occurrence and significance, Oppel says that they have been demonstrated in most vertebrates (doubtfully in the Selachia). He regards them as permanent structures and not transitory (as developing acini) and considers them of epithelial (entodermal) origin. On the other hand, whether or not they elaborate an internal secretion, he dares not decide, but should this be found to be the case, it does not, he thinks, militate against the view that they were originally part of the gland proper giving (possibly) a clue to the structure of the primitive gland. Blood vessels and nerves are considered next. The question of the occurrence of an accessory pancreas is then discussed. The development of the pancreas in the various vertebrate forms closes the chapter and is supplemented by a helpful table showing and comparing the mode of development in the different vertebrates as ascertained by the different workers.

In dealing with the various structures no attempt is made to discuss the gross anatomy as beyond the scope of the work, save in so far as necessary, though often—as in the case of the liver—references are given to the sources whence such information may be gained. It is likewise in accordance with the plan of the work to present the discussion in historical sequence, so that the liver is considered from the standpoint of (*a*) the liver lobule, and (*b*) the liver cell and gall capillaries, despite the fact that liver lobules are peculiar to mammals.

In the consideration of the remaining structural features of the liver, bile-duct and gall bladder are taken up, followed by a discussion of the liver in the different vertebrates. The development of the organ constitutes the closing division. Few original observations or generalizations are made in this portion of the work.

The comparison of the liver with other typical glands receives considerable attention, together with the question of the anastomosis of the gall-capillaries, and the conclusion is reached that a net-like arrangement of the gall capillaries occurs in the lower vertebrates, and in the higher forms at least in early development. Under the subdivision dealing with the functional activity of liver cells, the glycogen, pigment and fat content are discussed. Most investigators agree that there are two kinds of

liver cells, but there is no answer to the meaning of the differences.

The work as a whole is a valuable treasure-house of knowledge that will save both investigator and student much time and labor. The author does not state which system will form the subject of the next volume, nor when we may expect it to appear. At the same rapid rate of work it will be due in 1902, and we feel sure that the same excellence will be maintained.

B. F. Kingsbury.

RIVER PROFILES.

An interesting and valuable publication of the Department of Hydrography of the U. S. Geological Survey on the profiles of rivers in the United States, by Henry Gannett, has just been published and is now available for distribution. It embodies within a hundred pages the leading facts of about one hundred and fifty of the most important rivers and streams of the country, noting their length, drainage area, the location of water power in their courses, their peculiarities of flow and the nature of their drainage basins.

The rivers selected are those which are the largest in size and bear most directly upon the varied interests of the country such as the Connecticut, Hudson, Susquehanna, Ohio, Potomac, Mississippi, Missouri, Platte, Colorado, Sacramento, Columbia and others. The figures for the table showing the height above sea-level and fall per mile were collected from various sources. Some were obtained from the report of the chief engineer of the U. S. Army, some from railroad companies when their lines cross the streams and some from the atlas sheets of the U. S. Geological Survey. In the case of such rivers as the Connecticut, Susquehanna, Mississippi and Colorado, where the surrounding country is in part or whole of peculiar physiographic interest, very excellent and vivid descriptions of its leading physical characteristics are given, which add to the interest, and render it valuable from an educational standpoint in geographic and physiographic instruction. The pamphlet is the result of much careful work and is the first attempt to collect and compile this information in its present form.

SOCIETIES AND ACADEMIES.

ZOOLOGICAL CLUB, UNIVERSITY OF CHICAGO. WINTER QUARTER, 1901.

I.

The first meeting of the quarter on Jan. 9 was devoted to a paper by Professor F. R. Lillie, entitled 'A Comparison of the Power of Regeneration in Three Genera of Planarians, viz., *Planaria*, *Phagocata* and *Dendrocœlum*.' The following is an abstract of the paper:

"The greater part of the large volume of recent work on regeneration of planarians has been carried out on a single genus, *Planaria*. Attention should be called to the importance of the comparative method in studies of this kind. This may be illustrated by some results of observations on two other genera, *Phagocata* and *Dendrocœlum*. These three genera are found living together in a single pond in Falmouth, Mass. *Planaria* is especially abundant in this pond, in some parts of which as many as twenty or thirty individuals may be found on the under surface of a single large stone. Scattered about among these individuals one finds usually from one-half to one-third this number of individuals of *Phagocata* and two or three specimens of *Dendrocœlum*. *Planaria* is thus much more abundant than *Phagocata* and the latter than *Dendrocœlum*. The last is more abundant relatively in portions of the pond where there is a large amount of vegetation growing on the bottom. The habits of life of the three genera in question are, however, very similar.

"*Phagocata* was found to resemble *Planaria* very closely both in the modes of, and capacity for, regeneration. *Dendrocœlum*, however, offers the greatest contrast to both *Planaria* and *Phagocata*. The first experiment was to cut a single specimen in half through the pharynx. The cut surfaces healed and the farther fate of the parts was as follows: The posterior part formed no new tissues, although it lived for some days; from the anterior part, on the other hand, there grew out a pointed piece, which acquired the characters of a tail. Two weeks after the operation this piece also died without any extensive remodeling of the whole having taken place. I afterwards repeated the ex-

periment several times with a similar result. Thinking that the failure to regenerate a head might be due to the presence of the pharyngeal pouch, I then cut fourteen specimens transversely behind the pharynx. Two days after the operation an interesting difference in the reactions of the anterior and posterior parts was noticeable. While the former reacted in all respects like normal individuals, the latter showed no definite reactions of any sort but remained scattered over the bottom, some with the ventral surface up. In six days all the posterior pieces were dead without having shown any signs of regeneration, while all the anterior pieces, kept in the same dish, were living and regenerating new tails. This experiment was afterwards repeated with similar results, and I soon became convinced that, in this form, while a tail might regenerate at any place from the pharynx back, a new head could not be formed in this region of the body.

"The question was now, could a new head be regenerated in front of the pharynx? So specimens were cut in two immediately in front of the pharynx. The result of these experiments was that, while a very narrow border of new tissue might be formed at the cut border of the posterior piece, there was never any regeneration of even the semblance of a head. The anterior pieces, on the other hand, regenerated a new tail as before, and also a new pharynx.

"In the next experiment the heads of five individuals were removed by a transverse cut just behind the eyes. The heads did not regenerate, but in five days it was apparent that the decapitated pieces were regenerating new heads; in one piece the eyes could already be seen. On the next day eyes had appeared in all. The capacity for regeneration of a head was thus demonstrated.

"Two questions now remained: Was the regeneration of a new head due to the size of the piece, or to the position of the cut? and how far back does the capacity for regeneration of a head extend? The first question received a very simple answer; the head was first cut off just back of the eyes, and then from the anterior end of the major piece a small transverse piece was cut. In six days a rudimentary head with eyes developed on the front end of the small piece in one of three specimens.

"How far back does the capacity for regeneration of a head extend? We have seen that it cannot be formed from tissue just in front of the pharynx, but that it can be formed just back of the eyes. Twelve specimens were cut transversely about half way between the front end of the pharynx and the anterior end of the body. The reactions of both parts were perfectly normal, though the headless parts reacted much less rapidly than the parts with heads. In seven days both parts were rapidly regenerating and eyes had appeared in the headless parts; in the head-bearing parts the new pharynx was regenerating in the new tail. Both kinds of parts then completed the regeneration rapidly, though even after nineteen days the normal proportions were not restored.

"Thus in *Dendrocœlum* new tissue may grow out in the form of a tail at any transverse level of the body, excepting only the most anterior part to a very short distance back of the eyes; the capacity for regeneration of a head, however, is limited to the anterior third or fourth of the body. I do not mean to assert that the formation of a new head back of this level is completely impossible. Some one may at any time demonstrate, by taking suitable precautions, that a new head may be formed back of this level. But it is shown very clearly by these experiments that the power of regenerating a new head is largely, if not entirely, confined to the prepharyngeal part of the body in *Dendrocœlum*, and that it is always greater at any more anterior transverse level.

"Thus it is demonstrated that in *Dendrocœlum:* (1) The power of regenerating a head is limited to a small part of the body. (2) That a new tail may be generated at any transverse level. (3) That the capacity for remolding degenerating parts into normal proportions is very limited. (Limitation of 'morpholaxis,' Morgan.) (4) That there is a relation between the power of regeneration in this form and the power of performing the usual coordinated movements, the latter power always being slight in parts incapable of regeneration. This

last fact leads me to think that the nervous system plays an important part in regeneration of planarians. A paper, soon to appear, will deal more fully with these facts and the interpretation of them."

At the second session of the Club, held on January 23, Miss Elizabeth Meek gave the results of a statistical study of variation in the mandibles of the stony-beetle. An abstract of this paper has already appeared in Vol. XIII. of SCIENCE.

C. M. CHILD,
Secretary.

TORREY BOTANICAL CLUB.

AT the meeting of the Club on May 14, 1901, the scientific program was as follows: Professor Underwood spoke on 'The Genus *Pteridium*,' the type of which is the widely distributed and well known *Pteris aquilina* of Linnæus. It was separated from the genus *Pteris* by Gleditsch in 1751, followed by Scopoli in 1760. The principal generic character as distinguished from *Pteris* is the presence of a double indusium. Specimens of various species, varieties, and forms were shown, including extremely large specimens of *Pteridium aquilinum* collected by the speaker in southern France. Three species may be recognized in North America. The first of these is the common and variable *Pteridium aquilinum*, of which the recently described variety *pseudocaudatum* Clute is more or less common from New Jersey southward. The second species is *Pt. caudatum*, found in the extreme tropical of Florida. The third, which occurs in the West Indies, seems to be identical with a species originally described from Brazil, though it has been confused with a species from the Society Islands. Species from South Africa, India, and the Hawaiian Islands were also mentioned.

Dr. D. T. MacDougal gave an account of 'Carpotropic Movements of Flowers,' taking his illustrations from plants in bloom at the time. The two classes of movements of flowers are the induced or protective and the developmental or automatic. Of the former, the wild carrot furnishes a good example, its umbels being erect during the day and pendent or inverted at night. The segments of the perianth of the tulip also furnish a good illustration of movements induced by changing conditions of temperature.

Developmental movements, *i. e.*, those due to forces which originate within the plant, are well shown in the inflorescence of *Allium Neapolitanum*. The inflorescence here is nodding when in the bud, but the development of the flowers sends a stimulus to the curved portion of the peduncle, causing it to straighten. In addition, the plant is provided against accident by the fact that each pedicel has the power of independent movement. Each pedicel will bend so as to erect the flower if the peduncle is prevented from straightening. Under normal conditions the pedicels take positions separating the flowers equally. In *Claytonia Virginica* the buds are nodding, the flowers erect. After fertilization, there is another curvature, more abrupt and nearer the base of the pedicel. In *Streptocarpus*, the flower-stalk is curved and somewhat coiled in the bud, while the open flower is horizontal, bending the stalk at a right angle, and after fertilization the maturing fruit becomes erect. The movements of the fruit, in many cases at least, are for the better dissemination of the seeds, and the movements of the flower are commonly connected with methods of fertilization. Dr. MacDougal referred also to the curious development of the cotyledons in *Streptocarpus*. One of the cotyledons ceases to grow after a time, while the other elongates very much. In one species, this cotyledon remains the only foliage of the plant.

Dr. N. L. Britton gave an account of 'An Undescribed Species of *Stachys*.' He remarked that many North American species were until a few years ago referred to the *Stachys palustris* of Europe, but have more recently been recognized as distinct. A plant which grows on the sand hills along the beach near New Dorp, Staten Island, is really very different from the European *S. palustris*, and may safely be considered a new species. It has been collected in Michigan by Mr. Farwell and a specimen from Illinois is in the Chapman Herbarium. The species is apparently confined to sandy shores.

M. A. HOWE,
Secretary pro tem.

THE MINNESOTA ACADEMY OF NATURAL SCIENCES.

THE April meeting of the Academy, which proved to be a very interesting one, was addressed by Mr. F. K. Butters, who spoke on the 'Fungus Flora of Minnesota.' The more fundamental relationships of the fungi were illustrated by slides, taken from Engler and Prantl's 'Pflanzenfamilien,' and also by original microphotographs of common minute Phycomycetes and Ascomycetes, as well as by a large number of photographs of the fleshy fungi of the locality, taken in the field to show their natural conditions of growth.

The speaker pointed out that the fungi are to be considered as one of the most successful groups of the plants, showed by their diversity of form, the great variety of conditions under which they will grow and their numerical importance. In Minnesota the number of species is probably in excess of the flowering plants. The diverse conditions under which fungi will grow, *e. g.*, in water, upon living plants and animals, on decaying organic substances, in humus and in sand containing a minimum amount of organic matter was illustrated. Attention was called to the fact that on account of the great number of spores produced wherever there is suitable environment there also will be numbers of plants. The diverse forms of fungi are modifications of a few types to be regarded as distinct phylla and parallel lines of development sometimes exist in different groups.

The lecture was productive of a very general discussion of local fungi and was greatly enjoyed by the large audience present.

F. G. WARVELLE.

DISCUSSION AND CORRESPONDENCE.

GEOLOGY OF CHINA.

TO THE EDITOR OF SCIENCE: In the discussion in the last number of SCIENCE of my article in *McClure's Magazine*, there are some things which deserve attention in order to get the facts fairly before the public.

1. It is proper for me to state that the title of the paper and the headlines were put in by the editors; so that I was in no sense responsible for them. I think that in the article itself there are no offensive claims to original discovery.

2. The quotation from Geikie's 'Great Ice Age' (p. 699) is unfortunate for my critic, since it was that very quotation which misled me during a considerable portion of my trip. In this quotation Geikie says, "Its materials [those of the loess], we may believe, are largely of *fluvio-glacial* origin, and represent in great measure the flood-loams swept down from the mountains and plateaux when these supported extensive snow-fields and glaciers. But, as Baron Richthofen in his great book on China has demonstrated, the loess, as we now see it, owes its structure and heaping up to the action of the wind, and is even now forming and accumulating in many regions of Asia. It is, in short, a true steppe-formation." On page 697 Geikie had said, "According to Przevalski, undoubted traces of former glaciation are seen in the Suma-Hada range, west of Kalgan in China." My first point was to visit this mountainous region west of Kalgan supposed both by the Russian and by Geikie to be the source of the loess in Eastern China. But we found no indications of glaciation in that region, and pursued our investigations sufficiently to convince us that there were none; so that Geikie's theory of the 'fluvio-glacial origin' of the loess falls to the ground in that region. That came pretty near being a discovery.

3. On the same page Geikie says, "Kropotkin's researches have led him to conclude that the whole of the upper plateau of Asia and its border-ridges were under a mighty ice-cap." Assuming the truth of these statements, Geikie says upon the next page, "The mountain-valleys everywhere contain wide and thick sheets of rounded blocks, and coarse and fine gravel, which are in every respect comparable to the fluvio-glacial gravels of the Alps. But in none of the descriptions of these which I have read is there any clear indication as to whether the deposits occur in successive terraces like the high- and low-level terrace gravels of the Alpine lands of Europe. Something like this arrangement seems to be present in the valleys of the Thian Shan, and may possibly refer to recurrent phases of glaciation." In accordance

with this view, the glacial map of Asia which precedes the chapter is covered with extensive glaciated areas over the regions which I have specifically visited. All of which shows the confusion of mind which has widely prevailed up to the present time concerning the glacial conditions of Southern Siberia and Central Asia, and goes to justify the editor in naming my article.

4. I am not aware that Kropotkin had any personal knowledge of the southeastern border of West Turkestan. But it is significant that Geikie, on his authority, speaks of 'immense sheets and terraces of loess' fringing the base of its mountainous border. The writer in SCIENCE assumes, as I believe unwarrantably, that the only indication of a former sea-level is the occurrence of sea shells. On the contrary, in the broader studies of physical geography that are now current, sea-levels may be determined in many places by terraces where shells are not present.

5. With reference to the occurrence of the bones of land animals and of terrestrial mollusks in the loess, I need only to say, that the great uncertainty concerning the situation of these remains with reference to the original deposit largely, if it does not entirely, breaks the force of the argument which is drawn from it. No one will deny that the wind has in many instances redeposited vast amounts of loess, nor that subsequent streams have done the same. But to go no farther than our own country, it is difficult for any one who is familiar with the situation of the loess over Northern Missouri, for instance, or in the center of the Mississippi Valley at Vicksburg, to believe that it has been deposited either by the wind or by flowing streams of water when the land stood at its present level.

In due time I hope to bring the facts in fuller detail before the public. But this much I may confidently say, that the whole problem of the loess has not yet been fully comprehended, much less has it been solved. If the renewed discussion elicited by my report shall contribute to an understanding of the subject, a great point will be gained. But I am sure that the as yet little understood facts of Central Asia will contribute much toward a solution of what has been one of the most perplexing of all the geological problems.

G. FREDERICK WRIGHT.

'THE LARYNX AS AN INSTRUMENT OF MUSIC.'

TO THE EDITOR OF SCIENCE: Noting in your issue of May 24, a communication from Arthur Gordon Webster quoting Professor Le Conte's reference to the larnyx, comparing it in its function to a horn and citing a passage from Helmholtz containing the same comparison, I am tempted to refer your readers to a much earlier example of the same conception. I quote the following from some notes of mine: "In 1700 Dodart ('Memoire sur les causes de la voix de l'homme,' par M. Dodart, *Memoire de l'Academie des Sciences*, 1700, p. 238) insisted that the trachea only furnishes the material of the voice, *i. e.*, the expired air. The glottis is the only organ of the voice. All the effects of the glottis for tones depend on the tension of its lips, and of its various internal structures. The concavity of the mouth has no part in the production of the voice, but it is a modifier of it, and still more is this true of the nose. He showed that Galen's comparison to a flute could not be accepted if one were to go into details. He spoke of the vibration of the ligaments, of the dilatations and contractions of the glottis. He asserted that the trachea is elongated in high notes and shortened in low ones. He likened the vocal organ rather *to a horn or trumpet. According to him the glottis is the place which corresponds to the lips of the musician; the body of the instrument extends from the glottis to the external orifice of the vocal canal, that is to say the mouth.*"

JONATHAN WRIGHT.

SHORTER ARTICLES.

PREDETERMINED ROOT-HAIR CELLS IN AZOLLA AND OTHER PLANTS.

ORDINARY root-hairs arise in acropetal succession in the zone where the surface tissue is becoming fixed; that is to say, in a region at some distance from the root apex, where the cells have ceased to divide and have reached, or are reaching, full elongation. They come from any or all of the superficial cells indif-

ferently. "Only in Lycopodium," says De Bary (*Comparative Anatomy*, p. 60), "can special hair-cells be distinguished from the other epidermal cells of the root."

Special hair-cells are, however, to be found in a considerable range of plants, in which they form a rather striking anatomical character of the epiblema. In all the cases which I have studied, root-hairs arise from cells differentiated for the purpose at a very early stage of the epiblema, and *from no other cells*. The hair-cells are short, often very short, sometimes wedge-shaped, possess peculiarly dense and deep-staining cell contents, and are distributed in a manner determined by the mode of origin. They originate from the division of cells near the root apex. Of each cell pair formed, one becomes a hair-cell and very shortly shows distinctive characters; while the other either becomes a single ordinary, much elongated surface cell, or divides to form several such (hairless) cells. In most cases the cutting off of hair-cells seems to be a matter of stimulus. At times the roots are wholly devoid of hairs and hair mother-cells; at other times the growing conditions —as it would seem—call out these structures.

I find such special hair-cells in *Azolla*, *Isoetes*, *Selaginella*, *Equisetum*, certain Alismales and certain Nymphæaceæ.

In *Azolla pinnata* (the only species examined by me) the root shows several points of interest. The root-cap (as we may call the structure derived from the original segment cut from the outer face of the apical cell) consists of two cell layers, except at the apex, where the inner layer finally undergoes an extra periclinal division. The inner layer for a time coheres closely to the root-trunk, which is thus clothed with a true epidermis. At the same time the outer layer is separated from the inner except at the apex, and forms a distinct root-cap proper. The inner layer is finally pushed away from the root-trunk by the growth of hairs arising from the outer layer of the cortex, so that at maturity, and even before, the main body of the root is quite destitute of an epidermal covering.

The hairs arise in close proximity to the apex. Exterior cortical cells divide by a wall oblique to the external surface. The lower of the two cells so formed in each case almost immediately gives rise to a hair, while the other divides transversely to form two, four or eight hairless cells. At first the hairs stand in regular zones, but ultimately these zones often become more or less broken by the unequal multiplication of the intervening cells in the different vertical rows.

In several species of *Nymphæa* examined the hair mother-cells or the hairs themselves were found as apparently constant characters of the epiblema, alternating very regularly with ordinary cells. In *Nymphæa*, it will be recalled, the root is without epidermis (except root-cap), the epiblema being merely the outermost layer of cortex, the Nymphæaceæ in this respect agreeing with Monocotyledons and certain Pteridophytes. The hair-cells may develop in such a way as to give root-hairs, or they may be—under most conditions they commonly are—suppressed by the closing together, above them, of the ordinary elongated cells. Whenever hairs are found they proceed from short, specialized cells, early distinguishable not far from the growing point. An essentially similar condition is found in *Brasenia*, *Cabomba*, and *Nuphar*.

In some Alismales—*Sagittaria*, *Limnocharis*, *Aponogeton*—essentially the same phenomenon, the production of root-hairs solely from predetermined hair-cells, obtains. This is interesting in view of the recent discovery of the monocotyledonous character of one of the Nymphæaceæ.

I purpose in the near future to describe at length these and other like cases of root-hair formation.

R. G. LEAVITT.

THE AMES BOTANICAL LABORATORY,
NORTH EASTON, MASS.

QUOTATIONS.

SCIENCE AT A WESLEYAN UNIVERSITY.

THE dismissal of Professor Frank D. Tubbs from the chair of natural sciences in Wesleyan University, at Salina, Kansas, throws an interesting light upon the standards of orthodoxy in that State. Professor Tubbs is laboring under the grave charge of believing in evolu-

tion, a theory which the people described as 'the older and more orthodox Methodist ministers' so abominate that they will not even give Professor Tubbs a hearing. Apparently the general issue of academic freedom is not involved here, for the school professes to be a sectarian institution; that is, it subordinates the independent investigation of the truth to the propagation of certain doctrines. Professor Tubbs himself admits that his standing as a scientist, his success as a teacher and administrator, and his character as a man were not the only things considered in his appointment, for he says: "Bishop Vincent fully questioned my beliefs, approved them, and appointed me to the seminary." The only question is whether an evolutionist can be an orthodox Methodist in central Kansas. The trustees of the school say no. The decision may cause Professor Tubbs temporary inconvenience; but if belief in evolution is his only fault, he can comfort himself with the reflection that he is far better off than the 'university' at Salina. —The N. Y. *Evening Post.*

MR. CARNEGIE'S GIFT TO SCOTTISH UNIVERSITIES.

At the time when Mr. Carnegie's gift was first announced, and when nothing had been made known except its magnitude and the fact that it was intended to defray the cost of University education for Scottish students, we felt it necessary to point out, while cordially expressing our admiration of the munificence of the donor, that the very magnitude of the fund would render its wise administration a matter of some difficulty, and to call attention to circumstances which might interfere with the practical realization of the intended benefits. The conditions of the trust, as now disclosed, appear to meet, in almost every particular, the considerations which we mentioned. The application of half the income for the purpose of improving the apparatus of education and for establishing what can hardly fail to become world-renowned laboratories in every department of science which falls within the province of a university will at once lift those of Scotland to the very highest level of academic importance, and will be likely to place the country in the very forefront of practical scientific teaching and investigation. Medical science is specially mentioned in the trust, and, to take only a single example, it will be within the power of the trustees to enable any Scottish University to equip an expedition for inquiring into the life histories of fever-carrying mosquitoes or other insects, and thus to accomplish, perhaps in the course of a few months, more than could be accomplished by private enterprise, aided only by small and laboriously collected donations, even in the course of years. The problems of organic chemistry, again, are daily becoming of more and more importance in relation to health and to disease; as are those of inorganic chemistry in relation to a large number of manufacturing processes or industries. In respect of these and many kindred matters the great hindrance to scientific work in Great Britain has been simply want of means; and this want once removed, a very important step will have been taken towards assisting us to hold our own in the great industrial contests which the future can hardly fail to have in store for us, and in which scientific knowledge will certainly be one of the most important elements of success. We cannot but think that this section of the trust is likely, as time goes on, to prove itself infinitely the more important of the two, and that in the future, under the elastic terms and liberal powers of the deed, it may even come to swallow up or to supersede the general payment of fees which, after all, are not so large as to place a serious impediment in the way of any young man who is not absolutely destitute, and who is determined to push his way to the front of any calling in which it may be his purpose to engage.—The London *Times.*

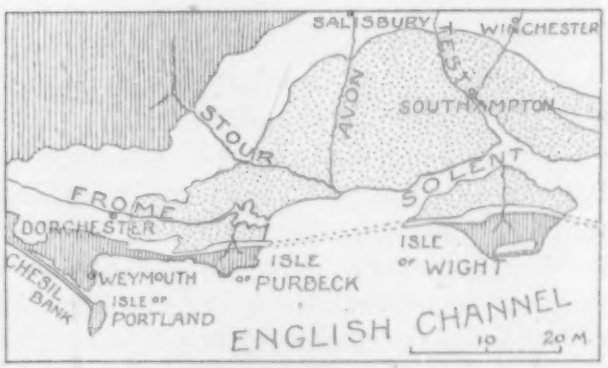
CURRENT NOTES ON PHYSIOGRAPHY.

THE SOUTH COAST OF ENGLAND.

The mid-southern coast of England is bordered by a narrow anticline of mesozoic strata, greatly eroded. The largest remnant of the anticline is the Isle of Wight, while further west a nearly isolated portion is called by the anticipatory name of the Isle of Purbeck. The physical features of the latter, with those of

the associated anticline of Weymouth, are treated in a chapter by Strahan ('The Geology of the Isle of Purbeck and Weymouth,' *Mem. Geol. Sur. England*, 1898, pp. 230–235). Next inland lies the unsymmetrical Hampshire synclinal basin of Tertiary strata, broadening eastward, and thus analogous to the London Tertiary basin. Each basin gave rise to an east-flowing axial consequent river, the lower Thames and the Frome; but while the valley of the Thames is still well preserved, the southern side of the original Frome valley has been greatly consumed by the sea. Lateral consequents of good size still come from the north, and one of them, the Stour, rises back of the chalk cuesta; but nearly all the consequents on the south have been shorn off; yet two small ones still remain, one on the Isle of Wight, one on the Isle of Purbeck, and each of these streams, like the Stour, heads back of the chalk, which on the south forms a monoclinal ridge of nearly vertical structure. Much of the original axial consequent has been destroyed; the river now called Frome being only the upper 30 miles of a stream that may originally have had a length of over 100 miles. The Solent estuary, separating the Isle of Wight from the mainland, is taken to be a middle part of the axial consequent, as described by Strahan in an earlier memoir (1896).

The Isle of Portland, south of Weymouth, is a smaller fragment of the devastated anticline, west of the other remnants. It is now connected with the mainland by the famous Chesil bank (*Ibid.*, pp. 203–209), a superb reef of pebbles and sand, 18 miles long, enclosing a shallow lagoon called the Fleet (from Saxon, meaning shallow water) for 12 miles. The exposed (southwest) face of the reef is a steep beach, benched with long, even terraces (locally called 'curbs'), the temporary records of the maxima in an irregular but generally decreasing series of wave efforts; the highest crest of the reef being the work of the master storm of the decade or century. The reef rests on clays which are sometimes exposed on the beach face after storms. Pebbles are abundantly thrown over the crest of the reef during on-shore winter gales; the windows of the nearest houses in Chiswell (where the reef joins the Isle of Portland) must then be boarded up, even though the crest is there 42 feet 9 inches above high-water mark. The reef as a whole must be marching slowly inland (northeast). It may have been formed originally several miles to seaward of its present position. The pebbles are largest at the southeastern end, where the reef is attached to the wasting and beachless cliffs of the Isle of Portland, and finest towards the northwest end, where it approaches but does not reach the Chalk uplands of Bridport; yet the commonest pebbles are not derived from the Portland sandstones, but consist of well-rounded chalk flints; and there are occasional Triassic pebbles, although no Triassic rocks are exposed for some 30 miles to the west. An earlier writer suggested that the movement of pebbles on the beach is from the northwest, and that the largest ones are now at the southeast end because they are most readily carried by storm waves and drift; but this is difficult to believe. Prestwich thought that the movement is to the northwest. Strahan seems to accept the earlier opinion, but concludes that the more persistent movement is only inward (northeast); and that the materials of the reef represent the most durable sweepings of the land area that has hereabouts been destroyed by the sea. Thus explained, it seems probable that the chalk flints and the Triassic pebbles were derived from exposures of these formations somewhere along the original position of the reef, a district now occupied by the northwestern part of the English channel.



Part of southern England, representing the Hampshire syncline and fragments of the adjoining anticline. Chalk, blank; older formations, lined; Tertiary, dotted.

THE ORIGIN OF FIORDS.

O. Nordenskiold contributes some 'Topographisch-geologische Studien in Fjordgebeiten' (*Bull. Geol. Inst. Univ. Upsala*, IV., 1899, pp. 157–226, 1 pl., 14 fig.), based on observations of fiords and on representations of their form by maps, soundings, etc. He finds normal or radial fiords (West Greenland, New Zealand), parallel fiords (Alaska, Patagonia), and combined forms (Norway). Fiords always occur in groups or systems. Their bottom is uneven, with deep basins and shallow swells. They are from 5 to 40 times longer than broad; they are enclosed by steep and high walls of strong rock. Their distribution shows that they stand in some relation to glaciers: glacial erosion of preglacial valleys best accounts for most features.

This inductive study furnishes many excellent descriptions of typical examples and a series of well-supported conclusions as to the prevalent features of fiords. In attempting explanation, the inductive method seems insufficient; a fuller consideration of what might be expected from long-lasting, vigorous glacial erosion is desirable; for unless the forms reasonably deduced from such a consideration match the observed forms, the theory of the glacial origin of fiords would be seriously at fault. It is perhaps because of the greater emphasis here given to the inductive than to the deductive part of the investigation that the discordant depths of confluent fiords are insufficiently explained, and that the important subject of hanging valleys, recently discussed by several observers, here receives no sufficient mention.

VIEWS OF THE COLORADO CAÑON.

'Glimpses of the Grand Cañon of the Colorado,' is the title of a portfolio of 13 colored plates published by Thayer, of Denver, Colo. It may be 'a fact that under certain conditions the cañon presents the marvelous colorings herein reproduced,' but such conditions are altogether exceptional; and the actual colorings under ordinary conditions are so strong and fine that there is no warrant for a resort in all the views to the exaggerated effects of a rare sunset. Not only are the reds too vivid, but the greens are those of a pluvial, not of an arid climate. The colored views of the cañon published by the Detroit Photographic Company from photographs by Jackson are on the whole to be preferred, not only from being more faithful and delicate but as well from being free from the distraction of more or less irrelevant poetical quotations with which the Thayer views are prefaced.

KABA VOLCANO, SUMATRA.

An entertaining account of the ascent of Kaba, a volcano in Sumatra, is given by Hagen ('Eine Besteigung des Vulkans Kaba auf Sumatra,' *Globus*, LXXIX., 1901, 245–250, 267–273). The illustrations from original photographs are remarkably well reproduced and exhibit the crater forms with unusual success. As in the 'curbs' or storm lines on a beach, so here, the existing craters represent the successive weakening maxima in irregular series of eruptions, all the minima being destroyed except the last.

W. M. Davis.

CURRENT NOTES ON METEOROLOGY.

WEATHER AND CROPS IN SAXONY.

An elaborate investigation into the relation of weather conditions and crop yield in Saxony, based on data for the period 1864–1897, leads to rather unsatisfactory results (Grohmann: 'Die phänologischen Beobachtungen der Jahre 1864 bis 1897, und die Ernteerträge im Königreich Sachsen in ihrer Abhängigkeit von den Witterungsverhältnissen,' Chemnitz, 1901). The various districts of Saxony are divided into three groups, and the results for these groups show striking agreement in comparatively few cases only. On the whole, it appears that there is a larger yield of winter grain in warm and dry than in cold and wet years. An influence of weather conditions upon the yield of summer grain cannot be demonstrated in many districts, and the only fact which does come out clearly is that a greater amount of moisture is necessary in order to produce a large crop of summer grain than a large crop of winter grain. In some cases an influence of higher spring temperatures upon the summer crop is indicated. Potatoes succeed best in years with warm summers and normal

precipitation. The smallest crops of beets and cabbages are usually obtained in dry, warm years. The largest crops of clover and grass come in years with excessive precipitation and high temperatures.

RAINFALL AND FORESTS IN INDIA.

AN important publication on Indian forestry has recently been issued, in which certain conclusions as to the climatic influence of forests are set forth. The book is entitled 'Forestry in British India,' and is by Berthold Ribbentrop, late Inspector-General of Forests to the Government of India (Calcutta, 1900). From a recent review of this volume (*Nature*, April 18, pp. 597–601) it appears that while the author does not distinctly maintain that by afforestation the climate might be improved as far as to stop the recurrence of droughts, it is evident that he is rather inclined to that opinion. He does say that "in a warm climate the denudation of a country diminishes its moisture and consequently its fertility." The regulation of surface drainage by forests is clearly pointed out.

PERIODICITY OF SEVERE WINTERS IN ENGLAND.

IN the *Quarterly Journal of the Royal Meteorological Society* for April is a paper by A. E. Watson, entitled 'A Review of Past Severe Winters in England, with Deductions therefrom.' From an examination of the records of the severe winters of the last 300 years, the writer comes to the conclusion that such winters are most frequent in the years with the numbers 0–1 and 4–5. He is also of opinion that the severe winter in the middle of each decade is generally a late one (Jan.–Mar.), while that at the beginning or end of each decade is generally an early one (Nov.–Jan.).

NOTES.

IN 'Hints to Travelers, Scientific and General,' edited for the Council of the Royal Geographical Society by John Coles (8th edition, London, 1901), there is an article by Dr. H. R. Mill on 'Meteorology and Climate,' the object of which is to supply the traveler with instructions to enable him to make use of meteorological instruments, 'and to obtain evidences of the climate of the region which he is passing through by noticing the effects produced on the land, vegetation, etc.'

MCADIE, of San Francisco, contributes a fourth paper on 'Fog Studies on Mount Tamalpais' to the March number of the *Monthly Weather Review*. In this he considers the refraction of sound waves by fog surfaces and the dissipation of fog. Two excellent half-tones accompany the paper.

BEGINNING with 1901 the Royal Observatory of Belgium will issue an *Annuaire météorologique*. Hitherto the *Annuaire* has been concerned with both astronomical and meteorological matters, but in the future the astronomical and meteorological divisions of the Observatory will have separate annual publications. The *Annuaire météorologique* for 1901 contains, among other matters, a sketch of the history of meteorology in Belgium and a review of two old meteorological journals, by J. Vincent; tables of monthly and annual means of the principal meteorological elements at Brussels and at Uccle, based at the former station on observations from 1833 to 1890, and at the latter from 1891 to 1899; and a paper on 'Le Climat de l'Ardenne,' by Lancaster.

R. DEC. WARD.

COLUMBIA UNIVERSITY BIOLOGICAL LECTURES.

FOR some years it has been the custom in Columbia University to have an annual course of public lectures on some biological topic. This year's series, recently completed, consisted of seven lectures on the Protozoa by Dr. Gary N. Calkins, of Columbia University.

The Protozoa, on account of their unicellular character, are of great importance in relation to many questions of general biology and especially physiology. The seven lectures by Dr. Calkins treated not merely the structure of the Protozoa, but their physiology, relations to more complex forms and the economic importance of certain types. The first lecture was a general sketch of the various discoveries which have gradually led to the recognition of the true relationship of Protozoa to Metazoa. This was followed by lectures on the four main types of Protozoa, in which physiology and

ecology of each were discussed as well as the morphology. The lecture on Sporozoa, which included a résumé of the life history of the malaria germ and other disease-producing Protozoa, was of unusual popular interest. In the sixth lecture Dr. Calkins discussed the renewal of vitality through conjugation, and the relation of conjugation to sexual reproduction of the Metazoa. The last lecture was devoted to a study of the Protozoan as a physiological machine, and was based largely upon the experimental work of recent years which has thrown so much light on the so-called 'vital' phenomena.

A point worthy of mention in connection with Dr. Calkins's lectures, since it contributed not a little to the value of the series, was the mode of illustration. For this purpose the stereopticon with microscope attachment was used, and photographic lantern slides, stained preparations and living Protozoa were thrown on the screen. Living Protozoa have often been thus projected, but in this case the highly perfected apparatus used rendered possible their projection on an unusual scale. *Amœba proteus*, for example, appeared five feet long, *Paramœcium aurelia* nearly four feet, so that many structures, nuclei, contractile vacuoles, etc., became plainly visible to a large audience. The stereopticon method proved especially valuable in demonstrating to large audiences the various 'tropisms' the positive and negative reactions, of certain Protozoa to chemical, electrical and other stimuli. By means of a specially devised electrical apparatus the lecturer was enabled to focus the projecting microscope from the lecture table.

Though the subject was a very special one, the mode of presentation and illustration was such as to render it highly interesting to the non-specialist, as was clearly shown by the large attendance at all the lectures.

J. H. McG.

THE BRITISH NATIONAL PHYSICAL LABORATORY.

The Friday evening discourse at the Royal Institution, on May 24 was devoted to an account of the aims of the National Physical Laboratory, by Mr. R. T. Glazebrook, its principal. According to the London *Times*, Mr. Glazebrook remarked that the idea of a physical laboratory, in which problems bearing at once on science and industry might be solved, was comparatively new; perhaps the first was the Physikalisch-Technische Reichsanstalt, founded in Berlin by the joint labors of Werner von Siemens and von Helmholtz, during the years 1883–87. It was less than ten years ago that Dr. Lodge outlined the scheme of work for such an institution in England, and in 1895 the late Sir Douglas Galton called attention to the question. A petition to Lord Salisbury followed, and as a consequence a Treasury Committee with Lord Rayleigh in the chair was appointed to consider the desirability of establishing a national physical laboratory. This committee examined over 30 witnesses and then reported unanimously, 'That a public institution should be founded for standardizing and verifying instruments, for testing materials and for the determination of physical constants.' It was now realized at any rate by the more enlightened of our leaders of industry that science could help them. This fact, however, had been grasped by too few in England, though our rivals in Germany and America knew it well; and the first aim of the laboratory was to bring its truth home to all, to assist in promoting a union which was certainly necessary if England was to maintain her supremacy in trade and manufacture, to make the forces of science available for the nation, to break down by every possible means the barrier between theory and practice, and to point out plainly the plan which must be followed unless we were prepared to see our rivals take our place. The effect of the close connection between science and industry on German trade might be illustrated, if illustration were wanted, by the history of the aniline dye manufacture and artificial indigo, and by the German scientific apparatus industry, the growth of which had been expressly attributed to the influence of the Reichsanstalt. Mr. Glazebrook proceeded to describe the means at disposal for realizing the aims of the laboratory. It was to be located at Bushey-house, Teddington, Kew Observatory remaining as the

observatory department. Bushey-house, in spite of its aristocratic history, would make an admirable laboratory. The building was very solid and substantial, and there was a good basement under the main central block with a roof of brick groining which afforded a very steady support for the floors above. The lecturer illustrated its plan with a number of slides, and compared it with the Reichsanstalt, which had an available space seven or eight times greater. But size alone was not an unmixed advantage, and personally he would prefer to begin in a small way if only he was in a position to do the work thoroughly. But there was a danger of starvation. Even with all the help the committee got in freedom from rent and taxes, outside repairs, and maintenance, the sum at its disposal was too small; £14,000 would not build and equip the laboratory, and £4,000 a year would not maintain it as it ought to be maintained. In America the Bill for the establishment of a laboratory which had just been passed authorized an outlay of £60,000 on buildings and site and an annual expenditure of £9,000. Was there no one who, realizing the importance of the alliance between science and industry, would come forward with more ample funds to start the laboratory with a fair prospect of success? Was there no statesman who could grasp the position and see that with double the income the chances of doing a great work would increase a hundred-fold? Give the institution means to employ the best men and it would answer the difficult problems it had to solve; starve it, and then quote its failure showing the usefulness of science applied to industry. In the concluding part of his lecture Mr. Glazebrook gave an account first of some problems of industry which had already been solved by the application of science, *e. g.*, glass for optical purposes, and then of some others which still remained unsolved and which the laboratory hoped to attack, *e. g.*, alloys, wind-pressure on bridges and similar structures, the exact determination of the relations between the scales of the mercury, hydrogen, and electrical resistance thermometers, and the magnetic testing of specimens of iron and steel, besides the standardization and calibration of various scientific instruments.

SCIENTIFIC NOTES AND NEWS.

AT the convocation exercises of the University of Chicago last week, a departure was made, in celebration of the tenth anniversary of the University, from the usual custom of not conferring honorary degrees. The LL.D. degree was conferred on ten men of eminence, including in the sciences, J. H. van't Hoff, professor of physical chemistry in the University of Berlin; Dr. A. Kovalevski, professor of zoology in the University of St. Petersburg; Dr. E. C. Pickering, director of the Harvard College Observatory; Dr. Charles D. Walcott, director of the U. S. Geological Survey, and Dr. E. B. Wilson, professor of zoology in Columbia University.

PROFESSOR A. S. PACKARD, who has held since 1878 the chair of zoology and geology at Brown University, has been elected a foreign member of the Linnean Society of London. The other American members of the society are: Alexander Agassiz, emeritus director of the Museum of Comparative Zoology, Harvard University; W. G. Farlow, professor of cryptogamic botany, Harvard University; D. H. Campbell, professor of botany, Stanford University, and C. O. Whitman, professor of zoology, University of Chicago.

AT its recent commencement Cornell College, Iowa, conferred the degree of LL.D. upon Mr. W J McGee, ethnologist in charge of the Bureau of American Ethnology, Washington. Dr. McGee is of Iowa birth and education, and one of his most important works, a classic in glacial geology, is 'The Pleistocene History of Northeastern Iowa.' The honor thus comes with special propriety from an Iowa school.

M. BERTHELOT (Paris) was elected an honorary member of the Vienna Academy of Sciences on June 1, and the following corresponding members were at the same time elected: Professors Schlegel (Leyden), Oppert (Paris), Linde (Munich), Retzius (Stockholm) and Kovalevski (St. Petersburg).

AT the recent meeting of the Royal Society of Canada, Professor A. B. Macallum, of the University of Toronto, and Mr. Lawrence M. Lamb, of the Geological Survey of Canada,

were elected fellows of Section IV. (Biological and Geological Division).

Sir Robert Stawell Ball, Lowndean professor of astronomy at Cambridge University, will present an address from the University at the bicentennial of Yale University.

Dr. Henry S. Pritchett, president of the Massachusetts Institute of Technology, has been invited to serve as superintendent of awards at the Pan-American Exposition.

Professors Charles O. Townsend and H. P. Gould have resigned from the Maryland Agricultural College, to accept positions in the Bureau of Plant Industry, Department of Agriculture.

Professor E. F. Emery has been appointed special agent of the Bureau of Animal Industry to study the dairy interests in China, Japan and the Philippines.

Dr. P. A. Rydberg, assistant curator at the New York Botanical Gardens, has been given a short leave of absence for a trip in Europe. He will visit the herbaria at Kew, British Museum, Christiania and elsewhere for the purpose of completing some critical studies of the genera in which he is interested, and of arranging for exchanges.

Dr. E. S. Riggs, of the Field Columbian Museum, is now engaged in exploring the fossil beds of Wyoming.

We regret to learn that Professor B. O. Peirce, professor of mathematics and natural philosophy at Harvard University, is still suffering from ill-health, and will probably be unable to resume his university work next year.

Dr. N. S. Shaler, professor of geology at Harvard University and dean of the Lawrence Scientific School, gave the annual address at the commencement exercises of the Worcester Polytechnic Institute.

The Pharmaceutical Society of Great Britain has presented its gold medal to Dr. George Watt, reporter on economic products for the Government of India.

The New York State Pharmaceutical Association has passed a resolution favoring the building of a State laboratory of pharmacy in memory of William Proctor, formerly professor in the Philadelphia College of Pharmacy.

A tablet in memory of Dr. Jesse William Lazear, who lost his life in the study of yellow fever in Cuba, was unveiled at Trinity Hall Military School, Washington, Pa., at its commencement exercises last week.

The Paris correspondent of the London *Times* telegraphs as follows: I have to announce with profound regret the death of one of the most eminent professors of the University of Nancy, M. Bleicher, who has been for six months at the head of the school of pharmacy in that city, after 20 years' service as professor of natural history at the same school. He was murdered by M. Raymond Four, a chemist, a sample of whose cinchona had been seized for analysis at the school, and who, dreading the results of prosecution for fraud, decided to hold the director of the school responsible for his humiliation and mischance. He called yesterday upon M. Bleicher and after a long interview shot him dead and then committed suicide. This monstrous crime has deprived France of one of the scholars who have done most to reveal to the world the geological interest of the frontier provinces of France. M. Bleicheis' 'Les Vosges, Le Sol et ses habitants' is a classical treatise which every traveller in Alsace-Lorraine should always carry with him. Every year Professor Bleicher spent his holidays on one or other of the slopes of the Vosges studying the stratifications, the rocks, the glacial marks, all the features, in a word, of this interesting region, upon which he had published a large number of memoirs. He had begun life as Médecin-Major in the French-African army, but left his work there in 1877 to become professor at Nancy, where he was very popular, often conducting students' scientific expeditions. No one so learned was ever more unassuming.

We regret to record the death of T. C. Clarke, which occurred in New York on June 15. Born in 1827, he graduated from Harvard University in 1848, and has been one of the most eminent American engineers, having designed and constructed many American bridges. He had been president of the American Society of

Civil Engineers and had received the Telford Medal of the London Institute of Civil Engineers.

THE death is announced of Mr. William Walton, formerly lecturer in mathematics in Cambridge University and the author of various text-books, at the age of seventy-seven years.

THE first award of the Mackinnon Research Studentship will be made by the Royal Society soon after the first of July. The value of the studentship is £150, and it will this year be awarded in one of the biological sciences.

THE position of aid in the Coast and Geodetic Survey, at a salary of $720 per annum, will be filled by civil service examination on July 23.

AN assistant in entomology in the State Museum at Albany will be selected by civil service examination on or about July 13. The salary, after October 1, will be $720 per annum.

THE New York City Board of Estimate and Apportionment has awarded the contract for completing the New York Public Library building to Norcross Brothers at a cost of $2,865,705.

A SOCIETY has been established in Germany for the study of medicine and the natural sciences, and will hold its first annual meeting at the close of the approaching meeting of German Men of Science and Physicians.

THE Royal Meteorological Society has collected a fund amounting to over £700 as a memorial to the late Mr. G. J. Symons. With this fund a gold medal will be established to be awarded once in two years for distinguished work in meteorology, irrespective of nationality.

THE Peary Arctic Club will send the steamer *Erik* to the North about the middle of July. Mr. Herbert L. Bridgeman will be in charge and Dr. F. A. Cook has accepted the post of surgeon.

PLANS are being made for the establishment of an institute of colonial medicine in Paris, for which about 250,000 francs have been subscribed.

THE Austrian Fishery Association will hold an international fishery exhibition at Vienna during the latter part of September, 1902, a subsidy for this purpose having been granted by the Imperial Department of Agriculture.

AN International Exposition of Hygiene Maritime Security and Fishery will be held at Ostende, Belgium, during August and September. An international congress will be organized in connection with the exposition for the discussion of questions of maritime hygiene and maritime and colonial security.

UNIVERSITY AND EDUCATIONAL NEWS.

MR. JOHN D. ROCKEFELLER has given $250,000 to Cornell University, on condition that an equal amount be contributed by others.

PRESIDENT HENRY MORTON, of the Stevens Institute of Technology, at Hoboken, N. J., has made a further gift of $50,000 for the new chemical building of the institute.

DR. D. K. PEARSONS has made the following conditional gifts: Illinois College, Jacksonville, $50,000; Fargo College, Fargo, N. D., $50,000; Whitman College, Walla Walla, Wash., $50,000; McKendree College, Lebanon Ill., $50,000; Bethany College, Lindsborg, Kans., $25,000; Fairmount College, Wichita, Kans., $25,000; Drury College, Springfield, Mo., $25,000.

AT the recent commencement at Smith College, President Seelye announced a conditional gift of $100,000, one-half for endowment and one-half for the building fund. The condition is that an equal sum must be raised within a year.

MR. J. V. THOMPSON, of Uniontown, Pa., has given $100,000 for the endowment of the president's chair of Washington and Jefferson College.

THE *Experiment Station Record* summarizes the appropriations made recently by State legislatures, according to which it appears that of the exceptionally large appropriations made by Missouri—$467,400 for two years—$40,000 is provided for a horticultural building and the same amount for a dairy and live-stock building. Kansas has appropriated over $200,000 for the biennial period for its agricultural college and station, including $70,000 for a new physics and chemistry building. Minnesota has appropriated $25,000 for a new chemical building and the same amount for a new veterinary building. Washington has appropriated $25,000 for a chemical laboratory. New Hamp-

shire has appropriated $30,000 for an agricultural building.

Among other recent bequests and gifts we note the following: By the will of the late John Sweetser, of Boston, Radcliffe College will ultimately receive $25,000. Mr. George A. Gardner has given $10,000 towards building a laboratory of electrical engineering for the Massachusetts Institute of Technology. Mrs. Maule, of Philadelphia, has given $10,000 to Princeton University to endow a fellowship in biology in memory of her son, F. Hinton Maule. Mr. Irwin Rew, a graduate of the Sheffield Scientific School of Yale University, has made a gift of $10,000 to the school. Mr. G. F. Peabody, of New York, has given to the Georgia State Normal School $3,000 to maintain a department of physiology for two years; he has also made a conditional donation of $10,000 to the school. Dr. Alexander Agassiz has given the School Department of Newport, R. I., $5,000, to be used to equip the biological, chemical and physical laboratories of the Cole School of Science. The trustees of the Mary Hemenway estate have appropriated $500 for an anthropological fellowship in Columbia University.

Two of the three positions offered by the Harvard Medical School to properly qualified men desirous of training in physiological research and in the management of large laboratory classes in experimental physiology are not yet filled for the next collegiate year. Holders of these positions give more than half the day to research. The remaining time is spent during the first four months of the collegiate year in learning laboratory methods and during the last four months in directing the laboratory work of the medical students, about two hundred of whom work from two to three hours daily for sixteen weeks in experimental physiology. The fundamental experiments in physiology done by so many men working at one time present every variety of results and impart a training not to be acquired in other ways. Much too may be learned by association with the large staff engaged in research in the laboratories of anatomy, histology, pathology, pharmacology, hygiene, physiology and physiological chemistry, all of which have their laboratories in the Medical School building. No charge of any kind is made either for the training in physiological research and in teaching or for the use of animals and other material. In addition to these opportunities each assistant receives four hundred dollars. Applications for these positions should be sent to Professor W. T. Porter, Harvard Medical School, 688 Boylston Street, Boston, Massachusetts.

Professor Winslow Upton, director of the Ladd Observatory, of Brown University, has tendered his resignation as dean, owing to ill-health.

W. D. Taylor, formerly head of the department of physics and engineering at the Louisiana State University, has been elected professor of engineering at the University of Wisconsin to succeed the late Professor N. O. Whitney.

Dr. Charles H. Judd will have charge of the department of psychology and pedagogy in the summer school of the University of Cincinnati.

Professor Bruce Fink, of Upper Iowa University, has been elected professor of geology and botany at Drake University, Iowa.

Fellowships in the sciences at Princeton University have been awarded as follows: Mathematics, Oliver D. Kellogg, James C. Moorhead and Adam M. Hiltebeitl; biology, Earl Douglass, Adam M. Miller; astronomy, John M. Poor; mental science, John K. Mackie; experimental science, Claude S. Hudson.

At the University of Wisconsin the following fellowship appointments have been made: Physics, E. R. Walcott; chemistry, H. E. Patten; pharmaceutical chemistry, I. W. Brandell; civil engineering, A. H. Blanchard.

Professor J. G. MacGregor, last year elected professor of physics in the University College, Liverpool, and prior to that professor of Dalhousie College, Halifax, has been appointed professor of natural philosophy at Edinburgh.

Dr. C. v. Kupffer, professor of anatomy and director of the Anatomical Institute of the University at Munich, has retired.

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